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DEPARTEMENT DE BIOLOGIE ANIMALE



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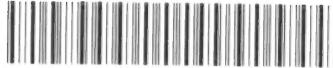
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## The 12<sup>th</sup> African Small Mammal Symposium

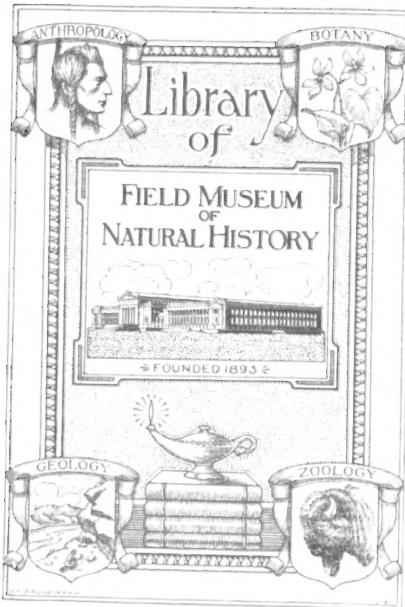
# Programme & Abstracts



12-17 April 2015, Mantasoa, MADAGASCAR



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# The 12<sup>th</sup> African Small Mammal Symposium

## Scientific Programme and Abstracts

12<sup>th</sup> ASMS  
Le Domaine de l'Ermitage  
Mantasoa  
Madagascar  
12-17 April 2015

Co-organized by Association Vahatra and  
the Département de Biologie Animale, Université d'Antananarivo,  
Antananarivo, Madagascar



and with the generous support of

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## **ORGANIZATION COMMITTEE OF THE 12<sup>TH</sup> AFRICAN SMALL MAMMAL SYMPOSIUM**

### *Local committee*

Steven M. Goodman, Field Museum of Natural History, Chicago, Illinois, USA and Association Vahatra, BP 3972, Antananarivo 101, Madagascar (co-chair)

Voahangy Soarimalala, Association Vahatra, BP 3972, Antananarivo 101, Madagascar and Institut des Sciences et Techniques de l'Environnement, Université de Fianarantsoa, Fianarantsoa 301, Madagascar (co-chair)

Martin Nicoll, WWF, BP 738, Antananarivo 101, Madagascar

Soanandrasana Rahelinirina, Institut Pasteur de Madagascar, BP 1274, Antananarivo 101, Madagascar

Martin Raheriarisena, Département de Biologie Animale, Faculté des Sciences, Université d'Antananarivo, BP 906, Antananarivo 101, Madagascar

Felix Rakotondraparany, Département de Biologie Animale, Faculté des Sciences, Université d'Antananarivo, BP 906, Antananarivo 101, Madagascar

Daniel Rakotondravony, Département de Biologie Animale, Faculté des Sciences, Université d'Antananarivo, BP 906, Antananarivo 101, Madagascar

### *International committee*

Steven Belmain, Natural Resource Institute, University of Greenwich, United Kingdom

Christiane Denys, Muséum national d'Histoire naturelle, Paris, France

Jean-Marc Duplantier, Institut de Recherches pour le Développement, Montpellier, France

Jörg Ganzhorn, Biocenter Grindel, The University of Hamburg, Hamburg, Germany

Paula Jenkins, The Natural History Museum, London, United Kingdom

Herwig Leirs, University of Antwerp, Antwerp, Belgium

Themba'lilahlwa Mahlaba, Department of Biological Sciences,  
University of Swaziland, Swaziland

Ara Monadjem, Department of Biological Sciences, University of  
Swaziland, Swaziland

M. Corrie Schoeman, School of Life Sciences, University of  
KwaZulu-Natal, South Africa

P. J. Stephenson, WWF-International, Gland, Switzerland

Peter J. Taylor, South African Research Chair on Biodiversity Value  
& Change, University of Venda, South Africa

## **Some important points**

### **1. Simultaneous translation**

As the participants attending the 12<sup>th</sup> ASMS come from an assortment of countries, including those being Francophone and Anglophone, presentations are welcome in both English and French. During the 12<sup>th</sup> ASMS we will have simultaneous translation between these two languages. Explanation on how to use the headphones will be given at the start of the opening ceremony (12 April) and the first day of scientific presentations (13 April). It is critical that the head phones, which are rented specifically for the 12<sup>th</sup> ASMS, do not leave the meeting room. When exiting the room we ask all participants to please leave the head phones on the table where they were picked up.

### **2. Student awards**

Awards will be given for the best student talk and the best student presented poster at the sum of 200 Euros and 100 Euros, respectively. All presentations eligible for these awards are designated with an asterisk (\*) in the following program and abstracts. A committee has been formed to make these evaluations. The award winners will be announced at the final banquet on 17 April.

### **3. Voluntary study of diseases for which mammalogists have been in contact**

During the course of the 12<sup>th</sup> African Small Mammals Symposium, The University of Pretoria, National Institute of Communicable Diseases and l'Institut Pasteur de Madagascar will conduct a study on zoonotic diseases mammalogists may have come into contact with. The Human Ethics Committee at The University of Pretoria has approved the project. Blood samples will be taken by qualified people working for l'Institut Pasteur de Madagascar during the **working day of 13 April** and the **morning of 14 April** at l'Ermitage, Mantasoa.

We would be grateful for all symposium attendees to take part in this study. A "participant consent form" will need to be filled in and signed, as well as a general questionnaire. Participants have the choice of remaining completely anonymous concerning the outcome

of the analyses or obtaining the results through a number code system.

#### **4. Uploading presentations**

We request that everyone making an oral presentation during the meeting upload their powerpoint file the **day before their presentation**. Please ask at the registration desk where you should upload your presentation.

# PROGRAMME

Sunday, 12 April 2015

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## OPENING CEREMONY

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**before 14:00** – Participants arrive/Arrivée des participants

**afternoon until 15:00** – Registration/Enregistrement

**15:00** – Invited officials arrive/Arrivée des invités officiels

Master of ceremony/Maître de cérémonie : Dr. Daniel Rakotondravony

**15:15** – Official opening ceremony/Cérémonie officielle d'ouverture

**15:15-15:30** – Presentation by the President of The University of Antananarivo on the importance and advancement of research at The University of Antananarivo/Discours du président de l'Université sur l'avancement et l'importance des recherches au sein de l'Université d'Antananarivo

**15:30-15:40** – Presentation by the General Director of Madagascar National Parks on the importance of conservation in Madagascar's protected area system/Discours du Directeur Général de « Madagascar National Parks » sur l'importance de la conservation de la faune dans les Aires Protégées

**15:40-15:50** – Presentation by the Ministre de l'Environnement, de l'Ecologie et de Forêt on faunal conservation in the protected areas system (SAPM)/Discours du Ministre de l'Environnement, de l'Ecologie et de la Forêt sur la conservation de la faune dans le système des Aires Protégées (SAPM)

**15:50-16:00** – Presentation by the Ministre de l'Enseignement Supérieur on the importance of scientific research in different national institutions/Discours du Ministre de l'Enseignement Supérieur sur l'importance des recherches dans les différentes institutions nationales

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Official opening of the symposium/Ouverture officielle du symposium

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**16:00-16:45** – Presentation by Steven M. Goodman on the mammals of Madagascar/Présentation par Steven M. Goodman sur les mammifères malgaches (Alexander von Humboldt Foundation lecture)

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**17:00** – Reception-buffet-dinner/Réception-dîner (buffet) (hosted by The Alexander von Humboldt Foundation)

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**21:00** – Shuttle from l'Ermitage to other hotels

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## Monday, 13 April 2015

Note 1: only the presenting author is mentioned in this program. For the full list of authors, please see the relevant abstract in the latter portion of this book.

Note 2: name of presentor marked with an asterisk (\*) is eligible for student prize.

### Blood sampling at “clinic” throughout day by staff from Institut Pasteur de Madagascar

7:00 – hotel pickup with shuttle buses and transport to l'Ermitage

6:30-8:15 – breakfast at l'Ermitage

8:25-8:30 – announcements

#### Plenary I

Plenary chair: Steven M. Goodman

8:30-9:00 Peter J. Taylor  
Afromontane small mammals feel the heat

#### Session: Impact of climate change on mammals

Chair: Ara Monadjem

9:00-9:15 \*Ryan Kok  
Climatic impacts on the functional diversity of Malagasy bats

9:15-9:30 Ivana Schoepf  
Rain or shine, I will survive: Inter-individual variation in the ability to cope with extreme climatic changes affect survival in a non-desert specialist in an arid environment

9:30-9:45 \*Frederik Van de Perre  
Diversity of rodents and shrews in the Yangambi Biosphere Reserve, DR Congo

#### Session: Management of rodent populations

Chair: Herwig Leirs

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<b>9:45-10:00</b>	Rhodes H. Makundi Acceptance of bait containing contraceptives levonorgestrel and quinestrol by the multimammate rat, <i>Mastomys natalensis</i>
<b>10:00-10:15</b>	Emil von Maltitz Chemical control: short-term solutions to manage gerbil damage to maize in reduced tillage systems on sandy soils in South Africa
<b>10:15-10:30</b>	Frikkie Kirsten Introducing ecologically-based rodent management to smallholder farmers in Gauteng Province, South Africa
<b>10:30-11:00 – coffee/tea break</b>	
<b>Session: Rodent phylogeny and ecology</b>	
<u>Chair:</u> Jean-Marc Duplantier	
<b>11:00-11:15</b>	Christiane Denys Evolutionary history of Nesomyidae (Rodentia) in light of molecular and paleontological data
<b>11:15-11:30</b>	Arame Ndiaye Molecular phylogeny of <i>Gerbillus</i> (Rodentia: Gerbillinae) using mitochondrial and nuclear genes: Taxonomic and biogeographic implications
<b>11:30-11:45</b>	Jacques Mwanga Milinganyo <i>Lophuromys woosnami</i> and murid rodents as ecological indicators of the degraded highland forest of Kahuzi-Biega, eastern DR Congo
<b>11:45-12:00</b>	*Benny Borremans Scaling of contacts with rodent population density
<b>12:00-12:15</b>	Themba'lilahlwa A. M. Mahlaba Seasonal change in the age distribution of <i>Mastomys natalensis</i> at Luyengo, Swaziland
<b>12:15-12:30</b>	Rebecca Rimbach Transgenerational effects of dietary protein on life-history characteristics in the African striped mouse <i>Rhabdomys</i>

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**12:30-13:45** – lunch and visit to “clinic” for blood sampling

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**13:45-14:00** – announcements

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**Session: Insights into different aspects of the Afrotheria**

Chair: Peter J. Taylor

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**14:00-14:15** Link E. Olson

Phylogeny and biogeography of tenrecs revisited again

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**14:15-14:30** \*Kathryn M. Everson

Species delimitation using Next-Generation Sequencing in Madagascar's shrew tenrecs (*Microgale*)

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**14:30-14:45** Katarina Medger

Effects of captivity and environmental enrichment in the eastern rock sengi

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**14:45-15:00** Heike Lutermann

Dynamics of the within-host parasite community of the eastern rock sengi, *Elephantulus myurus*

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**15:00-15:45** – coffee/tea break

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**15:45-16:45** – installation of posters in designated room following poster number “P” system (see poster abstract section within this book) indicating where each should be placed.

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**Balance of afternoon** – free time and visit to “clinic” for blood sampling

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**19:30** – dinner

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**21:30** – shuttle from l'Ermitage to other hotels

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## Tuesday, 14 April 2015

Note 1: only the presenting author is mentioned in this program. For the full list of authors, please see the relevant abstract in the latter portion of this book.

Note 2: name of presentor marked with an asterisk (\*) is eligible for student prize.

**Blood sampling at “clinic” during the morning. Specimen collection for this project ends before departure for Andasibe.**

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**7:00** – hotel pickup with shuttle buses and transport to l'Ermitage. For those not staying at l'Ermitage, **PLEASE BRING NEEDED OVERNIGHT BAGGAGE FOR ANDASIBE. OTHER BAGGAGE CAN BE LEFT IN YOUR HOTEL ROOM.**

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**6:30-8:15** – breakfast at l'Ermitage

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**8:25-8:30** – announcements

### Plenary II

Plenary chair: Steven M. Goodman

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**8:30-9:00**      Koussay Dellagi  
Which factors might account for the contrasted epidemiology of human leptospirosis in the southwestern Indian Ocean Islands?

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**Session: Zoonotic studies of western Indian Ocean island mammals**

Chair: Pablo Tortosa

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**9:00-9:15**      \*Julien Mélade  
Serological evidence of *Lyssavirus* infection in bats from the southwestern Indian Ocean islands

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**9:15-9:30**      \*Yann Gomard  
Pathogenic *Leptospira* in Malagasy bat species show strict host parasite specificity suggestive of long-term co-evolutionary processes

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**9:30-9:45**      Jean-Marc Duplantier  
The altitudinal distribution of plague in Madagascar: relationship with distribution of potential reservoirs and vectors

9:45-10:00	Soanandrasana Rahelinirina Seroprevalence of plague infection in small mammals in Madagascar from 1998 to 2014
10:00-10:15	Alan Harrison The effect of host diversity on the prevalence of <i>Bartonella</i> in peridomestic small mammals in Madagascar
<b>10:15-10:45 – coffee/tea break</b>	
<b><u>Session: Zoonotic, ectoparasites, and pollutant studies of African mammals</u></b>	
	<u>Chair:</u> Steven R. Belmain
10:45-11:00	*Marinda Mortlock Detection of a diverse range of paramyxoviruses from African bats
11:00-11:15	*Terence P. Scott Seasonal and ecological influences on the population dynamics of a <i>Rousettus aegyptiacus</i> colony in Limpopo, South Africa
11:15-11:30	*Stewart D. McCulloch Seasonal variation in Lagos bat virus neutralizing antibody levels present within a population of <i>Rousettus aegyptiacus</i> fruit bats in the Limpopo Province of South Africa
11:30-11:45	Herwig Leirs Arenaviruses and African rodents: A model system for studies in ecology and evolution
11:45-12:00	*Sophie Gryseels Evolutionary ecology of <i>Mastomys natalensis</i> -borne arenaviruses
12:00-12:15	*Samantha Naidoo The effect of pollutant exposure on detoxification organs in an urban adapter, the Banana Bat, foraging at wastewater treatment works

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**12:15-12:30** \*Christophe Diagne  
Rôle des parasites dans le succès d'invasion :  
Approche corrélative sur deux communautés  
parasitaires dans le contexte de l'invasion de *Mus  
musculus domesticus* au Sénégal

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**12:30-13:30** – lunch

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**13:45** – depart for Andasibe

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**~15:45** – arrive at Feon'ny ala (Andasibe), with some free time to  
install and relax

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**~17:30** – depart for night walks and bat netting at Mitsinjo  
(Andasibe)

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**~20:00** – return for dinner (Feon'ny ala)

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## **Wednesday, 15 April 2015**

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**5:30-6:00 – breakfast (Feon'ny ala)**

**6:00 – depart for Mitsinjo (about ½ group, checking traps, with some bird and lemur watching) and Analamazaotra (other ½ group, bird and lemur watching)**

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**6:00-10:30 – in forest**

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**10:30 – return to Feon'ny ala (Andasibe)**

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**11:30 – lunch at Feon'ny ala (Andasibe)**

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**13:00 – loading of buses and return to l'Ermitage and satellite hotels (Mantasoa)**

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**~15:00 – arrive at l'Ermitage (Mantasoa), drop-off at satellite hotels**

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**16:00 – round table discussions (to be announced)**

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**18:30 – satellite hotel pickup with transport to l'Ermitage (Mantasoa)**

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**19:30 – dinner at l'Ermitage (Mantasoa)**

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**21:30 – shuttle from l'Ermitage (Mantasoa) to satellite hotels**

## Thursday, 16 April 2015

Note 1: only the presenting author is mentioned in this program. For the full list of authors, please see the relevant abstract in the latter portion of this book.

Note 2: name of presentor marked with an asterisk (\*) is eligible for student prize.

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7:00 – hotel pickup with shuttle buses and transport to l'Ermitage

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6:30-8:15 – breakfast at l'Ermitage

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8:25-8:30 – announcements

### Plenary III

Plenary chair: Corrie Schoeman

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8:30-9:00 Wiesław Bogdanowicz (Alexander von Humboldt Foundation lecture)  
Bat refugia and their cryptic diversity

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**Session: Bats – different facts of recent research**

Chair: Corrie Schoeman

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9:00-9:15 \*Andrinajoro Rakotoarivelo  
Cryptic diversity in Commerson's leaf-nosed bat (Chiroptera: Hipposideridae) in the western dry forests of Madagascar

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9:15-9:30 Beza Ramasindrazana  
The ecology of Malagasy bats: Progress and challenges

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9:30-9:45 Paul Webala  
Effects of forest fragmentation on bats at Kakamega Forest, western Kenya

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9:45-10:00 \*Juliane Schaefer  
*Nycteria* parasite coevolution with African rhinolophid and nycterid bats

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10:00-10:15 David Jacobs  
Is interspecific competition for private frequency bands implicated in signal divergence in mammals?

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10:15-10:30 Anna Bastian  
Listening carefully: Increased perceptual acuity for species discrimination in multispecies signalling assemblages

**10:30-11:00 – coffee/tea break**

**Session: Humans, agriculture, and introduced mammals**

Chair: Link Olson

**11:00-11:15** Steven R. Belmain  
The StopRats project: The next step in delivering ecologically-based rodent management in Africa

**11:15-11:30** Anke Hoffmann  
Effects of different land use practices on the diversity and abundance of small mammals in Namibia, with special focus on the bushveld gerbil

**11:30-11:45** \*Fezile Mtsetfwa  
Assessing the impacts of large scale commercial agriculture on the activity and community composition of insectivorous bats in an African savanna, Swaziland

**11:45-12:00** Apia W. Massawe  
Variations in small mammal distribution, abundance and diversity under shifting cultivation agricultural practices in the north-eastern Tanzania

**12:00-12:15** Radosoa A. Andrianaivoarivelox  
To what extent are three types of deterring means efficient to control the loss of litchi crops consumed by Madagascar fruit bats?

**12:15-12:30** Fiadanantsoa Ranjanaharisoa  
Les mesures de mitigation sur les petits mammifères dans le site minier d'Ambatovy : activités et résultats

**12:30-12:45** Loth S. Mulungu  
Population dynamics and breeding patterns in two maize cropping calendars in eastern Tanzania

**12:45-14:25 – lunch and poster session**

**14:25-14:30 – announcements**

#### **Plenary IV**

Plenary chair: Steven M. Goodman

**14:30-15:00** Corrie Schoeman  
Community ecology of small mammals in the 21<sup>st</sup> Century: Trends and prospects

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**Session: Small mammal community ecology**

Chair: Beza Ramasindrazana

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**15:00-15:15** Laurent Granjon  
Forty years of monitoring rodent community and population dynamics at the Sahelo-Sudanian site of Bandia (Senegal): What has really changed?

**15:15-15:30** \*Gregory Mutumi  
Environmental factors driving lineage diversification in small mammals: A review

**15:30-15:45** \*Claude Fabienne Rakotondramanana  
Diversité du comportement alimentaire des Vespertilioninae au sein d'un assemblage de chauves-souris insectivores : cas de la concession forestière de Kirindy CNFEREF et de la forêt d'Antsahabe à Madagascar

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**15:45-16:15** – coffee/tea break

**Session: Small mammal distribution, diversity patterns, and community ecology**

Chair: Voahangy Soarimalala

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**16:15-16:30** \*William T. Stanley  
Elevational distribution and biogeography of shrews and rodents on Tanzanian mountains

**16:30-16:45** Prince Kaleme  
Small mammals diversity in Mount Hoyo (eastern DR Congo)

**16:45-17:00** \*Joa Braïthe Mangombi  
Composition de communauté de rongeurs et types d'habitats à Franceville, Gabon

**17:00-17:15** \*Toky M. Randriamoria  
Diversité et écologie des petits mammifères dans les habitats forestiers et non forestiers de Moramanga, centre-est de Madagascar

**17:15-17:30** Nico Avenant  
Small mammal succession in the Grassland Biome, South Africa

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<b>17:30-17:45</b>	*Hennie Butler Isolated small mammal communities: A scrutiny of the island rule
<b>17:45-18:00</b>	Ara Monadjem Local and landscape scale effects on small mammal populations in southern African savannas
<b>19:30 – dinner</b>	
<b>21:30 – shuttle from l'Ermitage to other hotels</b>	

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## Friday, 17 April 2015

Note 1: only the presenting author is mentioned in this program. For the full list of authors, please see the relevant abstract in the second portion of this book.

Note 2: name of presentor marked with an asterisk (\*) is eligible for student prize.

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**7:00** – hotel pickup with shuttle buses and transport to l'Ermitage

**6:30-8:15** – breakfast at l'Ermitage

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**8:25-8:30** – announcements

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### Plenary V

Plenary chair: Steven M. Goodman

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**8:30-9:00** Lounes Chikhi  
Some genetic consequences of population and social structure

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#### **Session: Genetics – phylogeography, phylogeny, and biogeography**

Chair: Lounes Chikhi

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**9:00-9:15** Aude Lalis  
Comparative phylogeography for five species of Moroccan rodents and shrews

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**9:15-9:30** Violaine Nicolas  
The phylogeography of the rodent genus *Malacomys* suggests multiple Afrotropical Pleistocene lowland forest refugia

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**9:30-9:45** \*Tatiana Aghová  
Comparative phylogeography of the Somali-Maasai savanna in eastern Africa using small rodents as a model

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**9:45-10:00** Petr Benda  
Phylogeny and taxonomy of the African Rhinopomatidae

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**10:00-10:15** Carine Brouat  
Invasion genetics of the black rat and the house mouse in Africa: a legacy of human history?

**10:15-10:30** Josef Bryja  
Genetic structure of rodents in Zambezian savannah - the role of rivers, mountains and climatic changes

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**10:30-11:00** – coffee/tea break

**Session: Small carnivores, squirrels, prosimians, and bat physiology**

Chair: Wiesław Bogdanowicz

**11:00-11:15** Adam W. Ferguson  
Africa's other carnivores: Assessing continent-wide knowledge gaps in small carnivore research

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**11:15-11:30** Samantha M. Wisely  
The role of mesocarnivores in ecosystem function in the lowveld of Swaziland

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**11:30-11:45** John L. Koprowski  
Conservation challenges, rarity and knowledge gaps for the squirrels of Africa

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**11:45-12:00** \*Juan Scheun  
Reproductive activity and its endocrine correlates in the African lesser bushbaby, *Galago moholi*

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**12:00-12:15** \*Jordi Salmona  
Towards conservation genomics of northern Madagascar mouse lemur

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**12:15-12:30** Andrew McKechnie  
Summit metabolism and metabolic expansibility in Wahlberg's epauletted fruit bats: Seasonal acclimatisation and effects of captivity

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**12:30-14:25** – lunch and poster session

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**14:25-14:30** – announcements

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**Session: Mole and root rats – research from the underground and labs**

Chair: Nigel Bennett

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14:30-14:45	Hynek Burda Ansell's mole-rats ( <i>Fukomys anselli</i> , Bathyergidae): From laboratory to the field - how representative are the laboratory studies?
14:45-15:00	Radim Šumbera How African mole-rats survive belowground? Infrared thermography approach
15:00-15:15	André Ganswindt Determining adrenocortical activity as a measure of stress in the Damaraland ( <i>Fukomys damarensis</i> ) and Natal mole-rat ( <i>Cryptomys hottentotus natalensis</i> )
15:15-15:30	*Michaela Morhart New insights into postnatal development-, growth pattern- and behavior in a eusocial rodent, the naked mole-rat ( <i>Heterocephalus glaber</i> )
<b>15:30-16:00 – coffee/tea break</b>	
<b>Session: Mole and root rats – research from the underground and labs (continued)</b>	
<b>Chair: Daniel Rakotondravony</b>	
16:00-16:15	*Erich Pascal Malkemper New insights into the magnetic sense of African mole-rats
16:15-16:30	Sabine Begall How to trigger mating behaviour of Zambian <i>Fukomys anselli</i> mole-rats?
16:30-16:45	*Yoshiyuki Henning Unusual thyroid hormone ratio in Ansell's mole-rats - a novel mechanism to cope with hypoxic environment?
16:45-17:00	Maria Oosthuizen Exploratory behaviour, learning and memory in wild and laboratory Damaraland mole-rats

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<b>17:00-17:15</b>	Jan Šklíba Activity pattern and ecosystem function of the giant mole rat ( <i>Tachyoryctes macrocephalus</i> )
<b>17:15-17:30</b>	Nigel C. Bennett Reproduction in the East African root rat, <i>Tachyoryctes splendens</i> (Rodentia: Spalacidae), from Tanzania: The importance of rainfall
<b>17:30-19:30</b> – cocktail hour	
<b>19:30</b> – closing banquet	
<b>22:00</b> – shuttle from l'Ermitage to other hotels	

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## Saturday, 18 April 2015

Departing times for buses leaving directly for the Antananarivo airport (Ivato) associated with the following flights:

- Air Madagascar (MD 124) Antananarivo-Johannesburg – plane departure at 12:45 on 18 April and passengers need to be at Ivato by 10:30 – bus DEPARTING l'Ermitage at 6:30 (a.m.)
- South African Air Links (SA 8253) Antananarivo-Johannesburg – plane departure at 15:00 (3:00 p.m.) on 18 April and passengers need to be at Ivato by 12:30 – bus DEPARTING l'Ermitage at 8:00 (a.m.)
- Air Madagascar (MD 58) Antananarivo-Paris – plane departure at 23:00 on 18 April and passengers need to be at airport by 20:30 – bus DEPARTING l'Ermitage at 10:00 (a.m.). People taking this flight are suggested to take a day room at a hotel close to the airport, where they will be dropped off.
- Air France (AF 935) Antananarivo-Paris Charles de Gaulle – plane departure at 1:10 on 19 April, but passengers need to be at Ivato around 22:00 on 18 April. – bus DEPARTING l'Ermitage at 10:00 (a.m.). People taking this flight are suggested to take a day room at a hotel close to the airport, where they will be dropped off.
- Kenya Airways (KQ 260) Antananarivo-Nairobi – plane departure at 3:25 (a.m.) on 19 April and passengers need to be at Ivato at 1:00 (a.m.) – bus DEPARTING l'Ermitage at 10:00 (a.m.). People taking this flight are suggested to take a day room at a hotel close to the airport, where they will be dropped off

For those not leaving Madagascar on the 18<sup>th</sup> or the early Air France flight on the 19th, buses departing for Island Continent Hotel, Red Island Inn, Pousse-Pousse du Raphia et Résidence Raphia, and Auberge du Cheval Blanc at 10:00 (a.m.). For individuals staying at other hotels, you will be dropped off at a convenient place upon entering Antananarivo to obtain a taxi to your destination.

## **Abstracts for oral presentations**

Note 1: name of presentor marked with an asterisk (\*) is eligible for a student prize.

Listed in chronological order by session

### **Sunday, 12 April 2015 – opening ceremony**

An overview of Madagascar's small mammal fauna

Steven M. Goodman

Field Museum of Natural History, 1400 South Lake Shore Drive, Chicago, Illinois 60605, USA and Association Vahatra, BP 3972, Antananarivo 101, Madagascar

The native small mammals (Subfamily Nesomyinae and Family Tenrecidae) and bats (numerous families) have been the focus of taxonomical work for well over a century. There has been a steady increase in recognized levels of species richness throughout this period, but with nearly exponential growth over the past few decades associated extensive field inventories in different areas of the country. The level of discovery has been directly associated with the use of new capture techniques (e.g. pitfall traps, mist nets) and most importantly the use of molecular tools to better define species limits and recognize cryptic species. The past 20 or so years has seen the emergence of several generations of Malagasy mammalogists, working on an assortment of different organisms and topics. In this short review, the history of work on the small mammal and bat fauna of Madagascar is presented.

### **Monday, 13 April 2015**

#### **Plenary I**

**8:30-9:00**

Afromontane small mammals feel the heat

Peter J. Taylor<sup>1,2</sup>, Aluwani Nengovhela<sup>1,3</sup>, Lilian Odiyo<sup>1</sup> & Roderick M. Baxter<sup>1,3</sup>

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We predicted the potential impacts of climate change on two groups of Afromontane small mammals, forest shrews (*Myosorex*) and vlei rats (*Otomys*) from South Africa. Using a niche-model approach (Maxent), we investigated the potential impacts of climatic variables such as temperature and rainfall on the current and future (2050) distribution on these species. Eight bioclimatic variables for current and future projected scenarios together with occurrence data from recent collections in the Soutpansberg Mountains of Limpopo as well as South African museums and recent publications were used to build the models. The current and the future distributions for all species were compared in order to estimate range contractions, expansions or shifts. We modelled the current and future distributions of currently recognised species as well as two additional, newly proposed species (*O. auratus* and *M. cf. tenuis*). We predicted that specialist and range-restricted species, as well as those occupying higher elevations or latitudes should suffer greater habitat loss due to predicted temperature increases by 2050 under the A2 emission scenario. Our results generally supported these predictions. Species linked to temperate, montane grasslands (*M. varius* and *O. auratus*) were projected to suffer severe (> 50%) contractions in area of occurrence by 2050. The forest specialist, *M. cafer* was expected to lose 30% of its range but the shifted range included areas of eastern KwaZulu-Natal, which are almost entirely transformed. The wetland specialist, Western-Cape-endemic *M. longicaudatus*, is expected to lose >90% of its range by 2050. On the other hand, two sub-tropical species, *M. cf. tenuis* (endemic to Limpopo) and *M. sclateri* (endemic to northern KwaZulu-Natal) are expected to show range expansions; however, due to poor dispersal abilities and lack of suitable habitats, these expansions are unlikely to be realised. The IUCN Redlist status of all these species require revision.

## Oral presentations

### Session: Impact of climate change on mammals

9:00-9:15

Climatic impacts on the functional diversity of Malagasy bats

<sup>1</sup>\*Ryan Kok<sup>1</sup>, Steven M. Goodman<sup>2,3</sup> and M. Corrie Schoeman<sup>1</sup>

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Madagascar represents a global hotspot of diversity, which also faces numerous threats. Climate is an important environmental influence on ecosystems. However, the impact of projected climate changes on the distribution and diversity of Malagasy bats is currently not known. In this study, we modelled suitable habitat space of Malagasy bat species using environmental niche models (ENMs) under different climate scenarios. These include Last Interglacial (~120,000–140,000 ya), Last Glacial Maximum (~22,000 ya), current (~1950–2000), and the A2 (IPSL-CM4) climate scenario in 2080. We expected that changes in climate would influence bats similarly within functional groups and differently across functional groups. Specifically, we predicted that bats adapted to forage in vegetation (clutter functional group) are more affected than bats adapted to hunt insects near vegetation (clutter-edge functional group) and high above vegetation (open-air functional group). ENMs revealed that changes from warm to cold climates decrease the potential suitable habitat space of clutter bats yet increase those of clutter-edge and open-air bat species. In contrast, changes from cold to warmer climates increase the suitable habitats of clutter bats more than those of clutter-edge and open-air bats. Null model analyses showed that under both cold and warm climatic conditions, the observed overlap in suitable habitat between clutter and clutter-edge functional groups is lower than expected, whereas overlap in habitat between clutter-edge and open-air functional groups is more similar than expected by chance. Finally, our results suggest that future climate change may shift richness hot spots of bats into highly populated areas that are poorly protected. Future studies need to

consider effects of changes in human land use on suitable habitat availability of Malagasy bats.

**9:15-9:30**

Rain or shine, I will survive: Inter-individual variation in the ability to cope with extreme climatic changes affect survival in a non-desert specialist in an arid environment

Ivana Schoepf<sup>1</sup>, Carsten Schradin<sup>1,2,3</sup> and Neville Pillay<sup>1</sup>

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Climate change is testing species limits to adapt to harsh environments. Individuals need to adjust physiologically if they are to survive. The African striped mouse (*Rhabdomys pumilio*) is an ideal species to investigate how individuals survive in harsh environments, as it is not a desert specialist, yet it must endure drought during the summer before breeding in the moist season. We tested whether: 1) survivors differed in their general health status from non-survivors at the onset of the dry season (before conditions became harsh); 2) the general health status of non-survivors became worse than survivors during the dry season (when conditions were harshest); and 3) survivors restored their general health status once reaching the moist season (when conditions improved). To test whether survivors differed from non-survivors in their health status we collected blood samples from survivors throughout the dry and the moist season and from non-survivors until time of death. We measured 13 different blood parameters using VetsScan ABAXIS. At the onset of the dry season, survivors did not differ in their general health status from non-survivors. However, later in the dry season, the health of non-survivors deteriorated as they suffered from malnutrition and dehydration. Further, survivors restored their health status to levels similar to the onset of the dry season once reaching the moist season. Our results show that individual variation in the ability to cope with taxing conditions influences individual health and survival probabilities and have important conservation implications for species living in transient environments.

Diversity of rodents and shrews in the Yangambi Biosphere Reserve, DR Congo

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To mitigate global climate change, the UN-REDD+ strategy proposes to protect and enhance biosphere carbon stocks through the conservation of tropical rainforest systems. The conservation of animal and plant biodiversity is usually assumed to be a potential 'co-benefit' of protecting forests and the carbon stocks they correspond to. However, so far, studies demonstrate that biodiversity is rather weakly associated with the ecosystems' carbon stocks. Moreover, this association appears to be geographically variable, and can sometimes even be negative. The investigation of potential gains and risks associated with UN-REDD+ programs regarding biodiversity loss, requires a profound understanding of the underlying processes that influence the relationship between the carbon stock contained within a natural habitat, and its biodiversity. Our study intends to contribute towards a better understanding on the factors that link biodiversity and carbon stocks in different tropical forest habitats by analyzing this relationship for a wide range of animal and plant taxa. We studied 21 plots divided over secondary forest and several types of primary forest in the Yangambi Biosphere Reserve (D.R. Congo; 0.7557°N, 24.4889°E) with known aboveground carbon stock. In a subset of these plots, we inventoried small mammals, birds, insects (dipterans, ants, termites, etc.), trees, mushrooms, lichens and slime moulds. This presentation concerns the results obtained for rodents and shrews captured during two field campaigns (July 2013 and June 2014). The 617 specimens were identified up to species level using DNA Barcoding and were found to represent 14 rodent and 15 shrew species. We compared species diversity between sites using

sample-based rarefaction and extrapolation and calculated shared species estimators. The obtained diversity measures, weighted for sample completeness, were related to the carbon storage of the sites. Finally, we assessed the representativeness of our small mammal data by comparing it with comparable datasets from the region around Kisangani.

### **Session: Management of rodent populations**

**9:45-10:00**

Acceptance of bait containing contraceptives levonorgestrel and quinestrol by the multimammate rat, *Mastomys natalensis*

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In sub-Saharan Africa, the multimammate rat, *Mastomys natalensis*, is one of the most serious pests to cereal crops. The species is also a reservoir of important outbreaking zoonotic diseases including plague and Lassa fever that cause thousands of human morbidity and mortality cases each year, particularly among the rural poor. Conventional control strategies of this pest include rodenticides, which are most often unaffordable or not readily available during times of population outbreaks. Population reduction by rodenticides is often followed by rapid recovery due to immigration and prolific breeding activity within the same season. A potential novel approach that has been argued to be more effective to manage rodent population outbreaks is the use of contraceptives that reduce fertility of both male and female rats. In preliminary studies, we have evaluated the efficacy of two contraceptives, levonorgestrel and quinestrol, to control outbreaks of *M. natalensis* in Africa. These two fertility control chemicals have been used successfully to control Mongolian gerbils, *Meriones unguiculatus*, in China. We tested acceptance by *Mastomys natalensis* of bait containing contraceptive

treatments of either levonorgestrel or quinestrol at concentrations of 10 ppm, 50 ppm and 100 ppm, and treatments were compared with a plain bait control during a seven-day feeding period. Acceptance of the control bait was not statistically different ( $p < 0.001$ ) from the treatment of levonorgestrel at 10 ppm. Acceptance of bait treated with quinestrol at the three concentrations was significantly lower ( $p < 0.001$ ) than plain bait and levonorgestrel treatments at 10, 50 and 100 ppm. Significant interaction effects of treatment and sex were observed ( $F_{(16,392)} = 10.007$ ,  $p < 0.001$ ), with higher acceptance of treated bait for both levonorgestrel and quinestrol in female rats than male rats. Trials to establish bait consumption in choice experiments and effects of the contraceptives on reproductive performance of *M. natalensis* will be presented.

### 10:00-10:15

Chemical control: short-term solutions to manage gerbil damage to maize in reduced tillage systems on sandy soils in South Africa

Emil von Maltitz, Phanel Malebana and Frikkie Kirsten

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Rodent damage in commercial maize producing areas in South Africa at planting was more than 54 000 ha during the 2012 planting season, 57% occurring in the Free State Province. Damage occurred at the crop planting stage when rodents foraged on germinating maize seeds and newly emergent seedlings. In a year - long trapping survey, two *Gerbilliscus* species, indigenous and common to the area, dominated the rodent species diversity in and around crop fields, with the Highveld gerbil *Gerbilliscus brantsii* the species found within reduced tillage system maize crop fields in the northwest Free State. The effects of two types of chemical control were tested as potential short-term gerbil management tools for commercial maize. These were seed treatment at planting and burrow baiting with ready-bait rodenticides during vegetative growth. The use of zinc-phosphide as a seed-dressing proved effective for protecting maize seed against gerbils in non-acidic sandy soils. Both the rodenticides coumatetralyl and flocoumafen applied in gerbil burrows in maize fields after planting, and again before harvesting,

reduced gerbil activity by 70% in the three week trial period, but gerbil populations recovered when bait application was stopped.

**10:15-10:30**

Introducing ecologically-based rodent management to smallholder farmers in Gauteng Province, South Africa

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An integrated/ecologically-based approach for rodent pest management is increasingly viewed as more sustainable and cost-beneficial. However, such an approach requires a good understanding of the rodent species, their behaviour, breeding potential, and habitat utilisation in a given area. Unfortunately, these factors are poorly understood for pest rodent species in smallholder and peri-urban farming communities in South Africa. In 2011, a study was initiated in the Gauteng Province with the main objectives to: gather baseline knowledge necessary for ecologically-based rodent pest management; and conduct on farm rodent control demonstration trials, in rural/peri-urban mixed farming systems. Results from a knowledge, attitude, and perception survey indicate that: respondents question the efficacy of rodenticides and traps; believe acute poisons are more effective; and the majority felt that rodents are too clever to be trapped, or feed on rodenticides. Farm hygiene was, however, regarded as an important factor in rodent control management. In total, 18 farmers from three municipal districts volunteered to participate in rodent data collecting, and in on-farm demonstrations of rodent control trials. Rodent trapping started in September 2011 and continued at 6 weekly intervals over one year. Results indicate that the rodent numbers decreased during November to February, followed by an increase during March and April. In all study areas, *Rattus rattus* was the dominant species in feed stores, chicken houses and pigsties, and *Mastomys coucha* was dominant in vegetable gardens and garden edges. Species diversity differed considerably between the three localities, with the highest (five species) in one of the peri-urban study sites. A significant overlap in habitat utilisation between all the species was

found in all localities. The breeding cycles of the two dominant species *R. rattus* and *M. coucha* differ: the former shows no distinct breeding peak, while the latter peaks in September/October and in late to end summer, March/April.

### **Session: Rodent phylogeny and ecology**

**11:00-11:15**

Evolutionary history of Nesomyidae (Rodentia) in light of molecular and paleontological data

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The rodent Family Nesomyidae Major, 1897, contains numerous sub-tropical and Madagascar genera and represents the sister taxon of the very successful Muridae. Today represented by five Subfamilies (Cricetomyinae, Delanomyinae, Dendromurinae, Mystromyinae, Petromyscinae) in Africa and one in Madagascar (Nesomyinae), this family is composed of very diversified species whose relationships are not yet fully supported either by molecules or morphology. Recent molecular works indicate that the adaptive radiation of the Nesomyidae occurred between 235 and 5 Ma, and resulted from a complex paleogeographical history intertwined with movements of the Afro-Arabo-Asian tectonic plates. Moreover, recent paleontological studies have allowed the description of numerous genera and species, and even new subfamilies (Otavimyinae, Namibimyinae, Myocricetodontinae) whose affinities within Nesomyidae must be searched for in the context of recent molecular, morphological and morpho-functional studies. Here we aim for the first time to look at dental morphology of the entire family in light of recent molecular and paleontological work in an attempt to reconstruct an evolutionary scenario of the origins and diversification of the Nesomyidae.

Molecular phylogeny of *Gerbillus* (Rodentia: Gerbillinae) using mitochondrial and nuclear genes: Taxonomic and biogeographic implications

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The systematics of the arid-adapted and speciose rodent genus *Gerbillus* (>45 species) remains quite unclear; the limits and content of subgroups such as *Gerbillus*, *Dipodillus* and *Hendecapleura*, as well as species limits and relationships within the whole group have long remained confuse. Here, we used a molecular approach to reconstruct the phylogeny of the genus, thus allowing us to estimate divergence times between the main lineages and to update the systematics of the genus. The study was based on mitochondrial DNA (cytochrome *b*, 87 samples) and nuclear (IRBP, 71 samples) gene sequences of representative samples of 20 species covering most of the geographic distribution of the genus and spanning all previously proposed subgeneric assemblages. The phylogenetic tree evidenced four major clades that we propose to assign to four subgenera, namely *Gerbillus*, *Hendecapleura*, *Dipodillus* and, possibly, *Monodia*, the latter corresponding to a monospecific lineage represented here only by *G. nancillus*. We also show that the genus *Gerbillus* first diversify between 4.8 and 3.1 Myr bp. The main intrageneric assemblages originated at the very beginning of Pleistocene (around 2.5 - 2.1 Myr ago), while many of the specific lineages emerged around 1 Myr ago. These diversification events

seem to correspond to major bioclimatic fluctuations that have occurred in North Africa and the Middle East.

### 11:30-11:45

*Lophuromys woosnami* and murid rodents as ecological indicators of the degraded highland forest of Kahuzi-Biega, eastern DR Congo

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This study was conducted in the highlands of the Kahuzi-Biega Park, DR Congo. The aim of the study was to understand the relationship between the structure of the forest associated with post fire restoration and some parameters including species richness, dominance and diversity of rodents in order to identify the potential ecological indicators of a disturbed forest. Data on temporal variation of the studied parameters were collected on three occasions, between February 2013 and August 2014, in a predetermined area of 100 x 100 m. Two traps were set on each of 25 stations separated from one another by 25 m. All the rodents collected were identified to the species level. Four species were collected in the first period of the study. *Lophuromys woosnami* was the most abundant, representing 61% of all captures. In the second period, five species were collected and *L. woosnami* was the most abundant species (66% of captures). In the third period, six species were collected with *Praomys jacksoni* being the most abundant species (50% of captures) followed by *L. woosnami* (22% of captures). The dominance (0.45 and 0.48) by *L. woosnami* and the small biodiversity index (1 and 1.1) were characteristic for the first and second sampling periods, conducted in a young secondary forest. During the third period, the abundance of the undergrowth and the canopy created different microclimates, providing a complexity of habitats and presumably associated with the higher biodiversity index (1.32). These results suggest that *L. woosnami* dominance and a low biodiversity index could be potential indicators of disturbed forest in highland tropical forests.

**11:45-12:00**

Scaling of contacts with rodent population density

**\*B. Borremans<sup>1</sup>, J. Reijnders<sup>1</sup>, N. Hughes<sup>1</sup>, S. Gryseels<sup>1</sup>, R. Makundi<sup>2</sup> and H. Leirs<sup>1</sup>**

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Many rodent species exhibit periodic fluctuations in population abundance. This can have important consequences for processes known to be influenced by population density, such as dispersal, territoriality, reproduction and disease transmission. Evidence for the role of density has been almost uniquely gathered from observational field data, which makes it difficult to accurately detect causality or to quantify the effect of density. Using semi-natural field enclosures of 0.5 ha, we measured contact rates in Natal multimammate mice, a species known for its extreme population fluctuations, at a wide range of densities (10/ha – 280/ha). Contact rates increased in a density-dependent fashion, not linearly as may be expected but sigmoidally, reaching a maximum level at 160/ha. There was considerable individual heterogeneity in the number of contacts and in the degree of connectedness. This quantified relationship between density and contacts can be used to inform models of disease transmission or population dynamics, and can improve our interpretation of field data.

**12:00-12:15**

Seasonal change in the age distribution of *Mastomys natalensis* at Luyengo, Swaziland

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*Mastomys natalensis* from a middleveld study site, Luyengo, Swaziland, were used to study the age structure of the population using eye lenses to estimate age. The eye lens to age (in days) curve determined by Leirs (1994) was applied. A large percentage (62%) of *M. natalensis* in June (winter) were 2 months old while in October to March (spring/summer) the population consisted mainly (83%) of 3 month old specimens. A very low number of specimens (17/169) were older than 4 months, suggesting a high mortality/removal rate of the young especially in the winter months.

**12:15-12:30**

Transgenerational effects of dietary protein on life-history characteristics in the African striped mouse *Rhabdomys*

Rebecca Rimbach, Kerith Nel and Neville Pillay

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The level of dietary protein determines the onset of reproduction, affects offspring growth and maturation, and hence influences life-history traits and fitness. However, to date the long-term life-history consequences of protein deficiency are not well understood. We studied the transgenerational effects of different levels of dietary protein on the life-history and level of maternal behaviour of the striped mouse *Rhabdomys dilectus chakae* in captivity. We assigned breeding pairs to three treatments based on the percentage of dietary protein: baseline (BP; 19%); high protein (HP; 24%); and low protein (LP; 10%). Compared to the other treatments, reproductive output and offspring ontogeny was diminished in the LP treatment. Transgenerational effects were studied by breeding F2 females raised on the LP or HP diets on the same (HP-HP, LP-LP) or altered diets (HP-LP, LP-HP). The LP-LP treatment had no reproductive success, while reproductive capacity in the remaining treatments was determined mainly by the diet of mothers at breeding. Pups from protein-restricted females (LP, HP-LP) showed post-weaning compensatory growth. Timing of sexual maturity was mass-dependent in male and age-dependent in female pups. Females fed low protein diets during breeding (LP, HP-LP) displayed lower levels of maternal behaviour than females from the other treatments. This

study demonstrates that the level of dietary protein influences the life-history of *R. d. chakae* in predictable ways. The taxon responds to changes in dietary protein at breeding, largely regardless of its nutrition during rearing. Such phenotypic flexibility in life-history parameters allows *Rhabdomys* to adaptively respond to unpredictable environmental changes.

### **Session: Insights into different aspects of the Afrotheria**

**14:00-14:15**

Phylogeny and biogeography of tenrecs revisited again

Link E. Olson<sup>1</sup>, Kathryn M. Everson<sup>1</sup>, Voahangy Soarimalala<sup>2</sup> and Steven M. Goodman<sup>2,3</sup>

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Tenrecs (Afrotheria, Afrosoricida, Tenrecidae) are one of only four extant terrestrial mammal lineages to have colonized and diversified on Madagascar. Over the past 15 years, several studies have disagreed on relationships among major lineages of tenrecs, particularly the monotypic and morphologically distinct Malagasy genera *Geogale* and *Limnogale*, whose phylogenetic ambiguity has resulted in multiple interpretations of the number and timing of transoceanic dispersal events between Madagascar and Africa. We produced the first molecular phylogenetic hypothesis of all 34 currently recognized extant tenrecids—including the African otter shrews (Potamogalinae)—based on DNA sequence from three mitochondrial genes and eight nuclear exons. Bayesian and likelihood analyses strongly support monophyly of Malagasy tenrecs and all four traditionally recognized subfamilies. The semiaquatic *Limnogale* nests well within shrew tenrecs (*Microgale*), confirming its recent and rapid evolutionary specialization and justifying its taxonomic subsumption in *Microgale*. The two largest shrew tenrecs, *M. dobsoni* and *M. talazaci*, form a well-supported sister clade to all other *Microgale*; together with their craniodental synapomorphies, this supports their re-elevation to *Nesogale* Thomas 1918. The phylogenetic position of the enigmatic taxon *Geogale* remains

unresolved, and we confirm the existence of two deeply divergent lineages that partially explain discrepancies among previous studies that only included one or the other. We demonstrate for the first time the monophyly of all three African otter shrews and, in light of their ecological and morphological distinctiveness and antiquity, formally place them in Potamogalidae, thereby rendering extant Tenrecidae entirely endemic to Madagascar. Divergence estimates based on multiple fossil calibrations within Afrotheria place the arrival of tenrecs on Madagascar at ~30-50 MYA, with the subsequent appearance of major tenrecid ecomorphologies coincident with the formation of the island's major biomes.

#### 14:15-14:30

Species delimitation using Next-Generation Sequencing in Madagascar's shrew tenrecs (*Microgale*)

\*Kathryn M. Everson<sup>1</sup>, Voahangy Soarimalala<sup>2</sup>, Steven M. Goodman<sup>2,3</sup> and Link E. Olson<sup>1</sup>

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Discovery, documentation, and delimitation of species are challenging but essential endeavors for systematic biology, ecology, and conservation biology. Using large, multilocus molecular datasets can greatly increase the accuracy of species limit estimates, especially for lineages in the early stages of divergence. Madagascar's shrew tenrecs (*Microgale*) of the Family Tenrecidae form a natural model system for studying evolution and diversification. The recognized number of *Microgale* species has increased by more than 60% in the past 20 years, and preliminary evidence suggests that several species remain undescribed. Using Next-Generation Sequencing (NGS), we developed a nuclear genomic dataset to estimate species limits in a cryptic species complex within *Microgale*. We also generated mitochondrial sequence data for the same taxa using both NGS and Sanger sequencing. Both the mitochondrial and nuclear datasets revealed evidence for non-monophyly in *M. cowani*, suggesting the presence

of a new cryptic species. Additionally, mitochondrial data, but not nuclear data, supported non-monophyly in *M. fotsifotsy*. Here we outline a method for NGS species delimitation in a cryptic species complex and use it to identify species limits in Madagascar's shrew tenrecs, providing critical baseline data for conservation efforts in one of the world's most threatened biodiversity hotspots. We also discuss possible reasons for the discrepancy between nuclear and mitochondrial data and highlight the importance of collecting data from multiple inheritance pathways.

**14:30-14:45**

Effects of captivity and environmental enrichment in the eastern rock sengi

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Captivity can severely impact the behavioural and physiological processes of animals. This is mostly attributed to the reduction in space and stimuli available in comparison to the natural environment. It has been suggested that environmental enrichment, such as increased size and complexity of the captive environment, may counteract these detrimental effects. The present study investigates how captivity and environmental enrichment affects the activity patterns as well as cortisol and testosterone concentrations of the crepuscular eastern rock sengi (*Elephantulus myurus*). Sengis that had been kept in the laboratory for 1 to 2 years (captive) and newly wild-caught (wild) sengis were compared. Activity was measured for 30 days after which half the animals from each group received environmental enrichment (a stone, sand bath and live food) and conditions remained unchanged for the remainder. Activity was recorded for another 30 days. After the conclusion of the experiments, plasma cortisol and testosterone concentration were measured. Wild sengis were more active than captive sengis and animals of both groups were significantly more active when they received environmental enrichment. Enriched wild individuals had significantly higher activity levels than captive individuals and the activity of enriched captive individuals was similar to that of non-enriched wild sengis. In addition, cortisol concentrations were higher

in non-enriched compared to enriched sengis. Testosterone concentrations were lower in captive males than in wild males and enrichment appeared to increase testosterone concentrations in both groups. Our results highlight the dramatic effects that long-term captivity can have on activity, stress and reproduction in sengis. However, they also suggests that these can be ameliorated by implementing changes in maintenance conditions.

## 14:45-15:00

Dynamics of the within-host parasite community of the eastern rock sengi, *Elephantulus myurus*

Heike Lutermann and Sasha Hoffmann

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Most wild hosts are infested by more than one parasite species and infestations with a single parasite are rare. Since parasites rely on host resources and host size is finite, competition for both space and resources among parasites infesting the same host individual are likely. In addition, immune responses triggered by one parasite may increase a host's susceptibility to other parasites. Studies of interactions within parasite communities have focussed on helminth-microparasite interactions and are often correlational. In the current study, we monitored the ectoparasite community of eastern rock sengis (*Elephantulus myurus*) from the Limpopo Province, South Africa. We sampled the ectoparasite community of 125 individuals during 21,800 trap nights on eight study plots between March 2012 and April 2013. Half of the animals were treated against ectoparasites with Frontline®, a topical tick and flea dip, every two to three months, while the remainder was left untreated. Changes in ectoparasite community were recorded for short-term (i.e. days) and long-term (i.e. months) intervals. Sengis harboured a total of 57,882 ectoparasitic arthropods. Ten tick, one mite (chiggers) and one louse species (*Neolinognathus elephantuli*) were recovered with two tick species (*Rhipicephalus warburtoni* and *Rhipicentor nuttalli*), chiggers and lice being the most prevalent and abundant. Our treatment did significantly reduce *R. warburtoni* abundance, increased the abundance of chiggers while *Rc. nuttalli* and louse abundance were not affected at short intervals. No treatment effects were observed

over longer periods. Daily ectoparasite recruitment ranged from three (*Rc. nuttalli*) to 45 (*R. warburtoni*) for acari, while no louse recruitment was observed and this is likely to be linked to differences in life-history. There was evidence for weakly facilitating effects for several of the members of the ectoparasite community. Our data indicates complex interaction patterns and a high resilience of the ectoparasite community of sengis.

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**Tuesday, 14 April 2015**

**Plenary II**

**8:30-9:00**

Which factors might account for the contrasted epidemiology of human leptospirosis in the southwestern Indian Ocean Islands?

**Koussay Dellagi**

Centre de Recherche et de Veille sur les Maladies Emergentes dans l'Océan Indien, Plateforme de Recherche

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Leptospirosis, a zoonosis of global distribution, is a serious public health problem on the islands of the southwestern Indian Ocean, particularly on La Réunion, Mayotte, and the Seychelles. Curiously, very few human cases have been reported so far on Madagascar and the Union of Comoros. The pathogen belongs to different species that appear to differentially infect animal reservoirs and show heterogeneous geographic distribution among islands. This presentation will review at the regional level different field and laboratory results and discuss the impact of *Leptospira* diversity on the zoonotic cycles of the pathogen and risk of transmission to humans.

**Oral presentations**

**Session: Zoonotic studies of western Indian Ocean islands mammals**

**9:00-9:15**

Serological evidence of *Lyssaviru*s infection in bats from the southwestern Indian Ocean islands

\*Julien Mélade<sup>1,2,3</sup>, Stewart McCulloch<sup>4</sup>, Beza Ramasindrazana<sup>5</sup>, Erwan Lagadec<sup>1,3</sup>, Hervé Pascalis<sup>1,3</sup>, Steven M. Goodman<sup>5,6</sup>, Wanda Markotter<sup>4</sup> and Koussay Dellagi<sup>1,3</sup>

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Rabies virus and the rabies related lyssaviruses (Family *Rhabdoviridae*) have a near global distribution with many bat populations having been implicated as reservoir hosts. With the exception of Madagascar, the islands of the southwestern Indian Ocean (SWIO) have historically been deemed as rabies free despite the lack of epidemiological surveillance taking place within the local bat populations. In this study, we screened the individual sera of 464 bats, from 23 species belonging to 18 genera and five families, for the presence of *Lyssavirus* neutralizing antibodies by means of a miniaturized Rapid Fluorescent Focus Inhibition Test (RFFIT). The sample cohort was made of sera collected from 336 insectivorous and 128 frugivorous bats [specifically members of *Eidolon*, *Rousettus* and *Pteropus* genera] caught on five of the SWIO islands; Anjouan (Comoros archipelagos, n = 31), Mahé (Seychelles, n = 40), Mauritius (n = 67), La Réunion (n = 40) and Madagascar (n = 286). These sera were tested against three challenge viruses, two members of phylogroup I namely rabies virus (CVS), Duvenhage virus (DUVV), and Lagos bat virus (LBV) as a representative of phylogroup II. Fifteen bat species produced 197 individual samples able to neutralize at least one of the challenge viruses beyond the cut off dilution of 1:5 resulting in 42.5% seropositivity across the sample cohort. This level of neutralization differed between islands with Anjouan, Mauritius, Madagascar, Seychelles, and La Réunion

displaying seropositivity of 71.0%, 52.2%, 34.6%, 32.5%, and 22.5%, respectively. Although 17 samples were able to neutralize both CVS and DUVV there was no evidence of cross-neutralization between the members of phylogroups I and II. The results obtained in this study provide the first evidence of lyssavirus circulation within the bat populations of the SWIO islands. Although further work will be required to isolate and characterize the viruses present, our results suggest the presence of putative viruses from both phylogroups I and II with the former being more frequent and wide spread.

### 9:15-9:30

Pathogenic *Leptospira* in Malagasy bat species show strict host parasite specificity suggestive of long-term co-evolutionary processes

**\*Yann Gomard**<sup>1,2,3</sup>, Muriel Dietrich<sup>1,2</sup>, Beza Ramasindrazana<sup>1,3,4</sup>, Erwan Lagadec<sup>1,3</sup>, Steven M. Goodman<sup>4,5</sup>, Koussay Dellagi<sup>1,3</sup> and Pablo Tortosa<sup>1,2,3</sup>

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Leptospirosis, caused by pathogenic bacteria of the genus *Leptospira*, is considered to be a zoonosis of significant human medical importance on southwestern Indian Ocean islands. While these bacteria have been previously detected in a large broad range of mammal species, the bacteria/host associations and their evolutionary histories have thus far not been well studied at the molecular level, albeit such data being important in the epidemiology of this zoonosis. We characterized *Leptospira* infections in Malagasy bats and genotyped pathogenic bacteria in each positive sample with the aim of highlighting host specificity patterns within the

considerable bat fauna of Madagascar. Altogether, 947 bats (representing six families, 18 genera, and 31 species) were screened with a probe-specific real-time PCR targeting pathogenic *Leptospira*. Subsequent genotyping of the positive samples using three distinct markers, allowed the construction of bacterial phylogenies, which were then overlaid upon the molecular taxonomy of their host. Co-phylogenetic signals between bats and *Leptospira* were tested with global-fit methods and several co-evolutionary scenarios were examined using a reconciliation tool. Our results confirm that leptospiral infection is widespread in Malagasy bats species (infection rate = 21.4%, 203/947 positives) and reported for the first time in seven previously unscreened bat species. We identified several lineages belonging to *Leptospira kirschneri*, *L. borgpetersenii*, and potentially new pathogenic bacteria species. Phylogenies and global-fit methods showed that *Leptospira* display notable host specificity, suggesting that the *Leptospira* community within a given sampling site actually depends on the occurring bat taxa. The molecular dataset used to test distinct co-evolution processes indicates that duplication, co-speciation, and sorting events were the most probable evolutionary scenario leading to the observed leptospiral diversity. These findings are discussed in the light what is known about Malagasy bats, specifically their ecology and phylogeny.

### 9:30-9:45

The altitudinal distribution of plague in Madagascar: Relationship with distribution of potential reservoirs and vectors

J.-M. Duplantier<sup>1</sup>, S. Rahelinirina<sup>2</sup>, J.-B. Duchemin<sup>2</sup>, L. Rahalison<sup>2</sup> and S. Chanteau<sup>2</sup>

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Today, on Madagascar, rural plague exists only in the central part of the island, above 800 m of altitude. This distribution is not associated with the plague bacteria *Yersinia pestis*, as plague foci exist elsewhere in the world at sea level. In order to understand this

restricted distribution, four sampling transects have been completed running near sea level to the Central Highlands to determine the specific identification and abundance of reservoirs and vectors. Firstly, this work demonstrated that the black rat is the main reservoir and that indeed a single species is involved (*Rattus rattus*,  $2n = 38$ ) independent of the elevation. It represents 65 to 88% of the captures inside houses and 87 to 95% outside. The house mouse, *Mus musculus gentilulus*, is trapped only inside houses (6 to 26% of the captures). The Asian musk shrew, *Suncus murinus*, is the third most abundant species inside as well as outside houses. The sewer rat (*R. norvegicus*) is present only along the eastern sampling transect, along the road and the railway between the island's principal harbor (Toamsina) and the capital (Antananarivo). *Xenopsylla cheopis* is the most abundant flea on rats living inside houses and is rare outside, independent of the elevation. On the opposite, the endemic flea *Synopsyllus fonquerniei*, parasitizing *Rattus* living outside, is abundant in the Central Highlands, but absent at lower altitudes. These results confirm those of Brygoo (1966) concerning the absence of *S. fonquerniei* in human plague-free areas. Another important result in such areas is a lower abundance of rats inside and outside houses, and a near absence of fleas on rats living outside; this probably limits the dissemination of *Y. pestis* bacteria.

#### 9:45-10:00

Seroprevalence of plague infection in small mammals in Madagascar from 1998 to 2014

Soanandrasana Rahelinirina<sup>1</sup>, Jean-Marc Duplantier<sup>2</sup>, Steven M. Goodman<sup>3,4</sup>, Voahangy Soarimalala<sup>4</sup>, Lila Rahalison<sup>1</sup>, Suzanne Chanteau<sup>1</sup>, Sandra Telfer<sup>1,5</sup> and Minoarisoa Rajerison<sup>1</sup>

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The coexistence of both resistant and susceptible reservoirs for plague is considered important for the maintenance of *Yersinia pestis* in natural foci. The objective of our study was to assess the circulation of plague in small mammals trapped in Madagascar from 1998 to 2014. The analysis was based on the database held at the Plague Unit of Institut Pasteur de Madagascar. Serum samples collected from small mammals trapped in different areas in Madagascar were tested for IgG antibodies to *Y. pestis* using an enzyme-linked immunosorbent assay (ELISA). Among 37,234 terrestrial small mammals tested for plague antibody, 3443 (9.2%) were seropositive with 9.4% for introduced species and 4.5% for endemic species. Comparing seroprevalence in introduced hosts, *Rattus norvegicus* had the highest percentage of positive individuals (11.5%) compared with 6.1% of *R. rattus*. However, 10.2% of introduced Asian shrews *Suncus murinus* were positive. Rates of seroprevalence in endemic species were 18.4% of *Setifer setosus*, 17.1% of *Tenrec ecaudatus*, 14.1% of *Microgale* spp., 10.9% of *Oryzorictes hova*, 3.5% of *Eliurus* spp. and 2.9% of *Nesomys* spp. The seroprevalence rate increased with the age of animal and the majority of positive animals were captured outside human habitations. The most abundant animal caught in rural areas, *R. rattus*, showed high seroprevalence in hedges of sisal that occurred within 10 to 50 m of habitations. Plague can infect multiple hosts in Madagascar. Endemic species may be more important for plague epidemiology and, potentially, as sources of human infection than previously thought.

#### 10:00-10:15

The effect of host diversity on the prevalence of *Bartonella* in peridomestic small mammals in Madagascar

Alan Harrison<sup>1,2</sup>, Richard Hassall<sup>1</sup>, Skye Marshal<sup>1</sup>, Melissa Noble<sup>1</sup>, Minoarisoa Rajerison<sup>2</sup> and Sandra Telfer<sup>1,2</sup>

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The effect of host diversity on disease risk has been widely debated in the literature with both positive effects (where increased diversity

leads to increased disease risk, an “amplification effect”) and negative effects (where increased diversity leads to reduced disease risk, a “dilution effect”) being reported. Observations of a “dilution effect” have resulted in some claims that increased biodiversity may reduce the spread of wildlife pathogens to humans. However, data is lacking for most diseases and for sites where human exposure is expected to be high. *Bartonella* spp. are an emerging group of vector-borne zoonotic pathogens, with a number of species associated with clinical syndromes in humans such as cat scratch disease, Carrion’s disease and trench fever. They infect a wide range of mammals, including peridomestic species, and are transmitted by arthropod vectors such as fleas, lice and flies. Human communities in Madagascar are known to be at risk from rodent-borne infections, with one of the highest incidences of plague in the world. Using data from 23 sites in urban and rural areas that differed in peridomestic small mammal community richness, we investigated how host community composition affects the prevalence of *Bartonella* in small mammals. The most abundant host, *Rattus rattus*, appeared to share *Bartonella* genotypes with several other species and both the prevalence of *Bartonella* infection and flea infestation rates in *R. rattus* were positively associated with species evenness. In contrast, infections in the introduce insectivore, *Suncus murinus* were primarily of a genotype not found in other host species and the prevalence of *Bartonella* infection was positively associated with *S. murinus* abundance.

### **Session: Zoonotic, ectoparasites, and pollutant studies of African mammals**

**10:45-11:00**

Detection of a diverse range of paramyxoviruses from African bats

<sup>\*</sup>Marinda Mortlock<sup>1</sup>, Ivan V. Kuzmin<sup>2</sup>, Jacqueline Weyer<sup>3</sup>, Amy T. Gilbert<sup>4</sup>, Bernard Agwanda<sup>5</sup>, Charles E. Rupprecht<sup>6</sup>, Louis H. Nel<sup>1</sup>, Teresa Kearney<sup>7</sup>, Jean M. Malekani<sup>8</sup> and Wanda Markotter<sup>1</sup>

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Second to rodents, bats are one of the most specious groups of mammals with approximately 1200 species and counting. These small mammals have been implicated as reservoir to several viral and other pathogens capable of spill-over into animal and human populations. One such group of pathogens is the paramyxoviruses, known to also infect a range of other hosts including rodents, canids, birds and humans. Our aim was to gain insight into the distribution and diversity of paramyxoviruses in bat populations of sub-Saharan Africa. Several bat species from Cameroon, Democratic Republic of the Congo, Kenya, Nigeria, South Africa and Swaziland were sampled and a diverse range of approximately 32 putative paramyxoviruses was detected. Although specificity of some viruses was observed towards certain bat genera, other viral sequences clustered with known rodent viruses including J- and Beilong virus while one virus isolated from *Rousettus aegyptiacus* showed to be closely related to mumps virus, a known human pathogen. The relatedness between viruses from these different hosts, suggests that interspecies transmission is most likely taking place. This leads to the question as to whether researchers are at higher risk of exposure due to increased contact with these mammals. Insight into these viruses will be vital in understanding their pathogenic nature, cross-species transmission potential and viral dynamics within these different populations.

11:00-11:15

Seasonal and ecological influences on the population dynamics of a *Rousettus aegyptiacus* colony in Limpopo, South Africa

Stewart D. McCulloch<sup>1</sup>, \*Terence P. Scott<sup>1</sup>, Teresa C. Kearney<sup>2,4</sup>, Janus Paweska<sup>3</sup>, Ernest Seemark<sup>4</sup> and Wanda Markotter<sup>1</sup>

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Virological studies have historically solely focussed on the virological aspects of the host being studied, resulting in a biased and incomplete view of the virus-host interactions. With an improved understanding of the influences of a wide variety of internal and external factors on the host, the One Health approach has become increasingly important. The Egyptian fruit bat (*Rousettus aegyptiacus*) is the only known cave-dwelling fruit bat. This unique behavioural characteristic provides an exceptional platform for a One Health approach to understanding disease ecology through human-wildlife-environmental interactions with the host species. In our study, a *Rousettus aegyptiacus* population present at Mahune Cave in the Limpopo Province of South Africa was targeted for longitudinal One Health surveillance, with the ecological aspects being our focus in order to improve our virological understanding of the system. Monthly inspection and sampling of *R. aegyptiacus* bats was performed using harp trapping near to the entrance of - and visual inspection of the roosting colony within - the cave co-habited by up to nine other bat species. Temperature and humidity were recorded in four distinct locales within the different areas of the cave on an hourly basis over a period of 18 months. Additionally, population numbers and sex ratios were determined and correlated with the seasonality observed within the system, with a slight bias towards adults and no significant sexual bias. A single birthing season in November December was observed - in contrast to that of two

birthing seasons observed in central Africa. Population numbers spiked in the summer-time birthing season with colony estimates peaking at approximately 30 000 and dropping to approximately 2 000 in winter months. The ecological factors observed in our study have been shown to have a direct influence upon virological factors such as naivety and resistance to Lyssavirus infection.

### 11:15-11:30

Seasonal variation in Lagos bat virus neutralizing antibody levels present within a population of *Rousettus aegyptiacus* fruit bats in the Limpopo Province of South Africa

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Members of the order Chiroptera have long been associated with important zoonotic diseases. Rabies poses serious public health risks and has been shown to be involved in several spillover events from bats. Populations of *Rousettus aegyptiacus* (the Egyptian fruit bat) have historically been associated with Lagos bat virus (LBV) -a member of the rabies-related lyssaviruses- and the presence of antibodies able to specifically neutralize this viral species. In an attempt to understand this viral-host relationship, we undertook a longitudinal study on a *R. aegyptiacus* population present year-long at the Mahune Cave system in the Limpopo Province of South Africa. To determine the exposure to this virus and the colony's seroprevalence, monthly serum samples were collected from a minimum of 50 individuals. Upon their first capture, by means of harp traps near to the entrance of the cave, each individual was issued a unique alpha-numeric tattoo. These facilitate monitoring through recapture events and the correlation of samples from the same individual at different time points. In order to determine virus neutralizing antibody titres to LBV, the Rapid Fluorescent Focus

Inhibition Test (RFFIT) was performed in triplicate on each serum sample. The results demonstrated an average of 57% population exposure but with fluctuations of antibody presence between 29 - 86% of the specific months' sampled individuals. These results can be used to infer times of year with increased viral circulation and thus high risk periods for subsequent zoonotic spillover events. The monthly cross section of the colony shows no sexual bias but a slight adult preference in antibody distribution, the presence of over 100 recapture events has provided unique evidence for the serological conversion and waning of antibody protection in naturally infected and free living *R. aegyptiacus*.

**11:30-11:45**

Arenaviruses and African rodents: A model system for studies in ecology and evolution

Herwig Leirs & collaborators

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Arenaviruses are a group of RNA viruses that nearly all have rodents as their natural reservoir. In Africa, Lassa virus, causing a serious hemorrhagic fever in humans in West Africa, is one of them, but recently, several new viruses have been discovered in different rodent species. Most arenaviruses are host-specific, or even linked to separate lineages within a rodent species. In *Mastomys natalensis*, at least four different arenaviruses are known and other viruses occur in closely related rodents in the *Mastomys-Praomys* group. This makes this assemblage a very interesting model for the study of host-parasite evolution. In some cases, virus and rodent diversity are paralleled, while in other cases, viruses seem to have crossed evolutionary lines in the rodent phylogeny. In Tanzania, we observed a narrow hybrid zone between two *M. natalensis* lineages, each with their own arenavirus, which seems not to invade into the other host lineage. We are currently investigating whether this is due to evolutionary processes or due to ecological barriers. We isolated Morogoro virus, from *M. natalensis* in Tanzania. Since the ecology of these mice has been studied extensively and the virus is not pathogenic for humans, we use it as a model to study fundamental aspects of arenavirus ecology, and host-parasite ecology in general. We developed mathematical models for the transmission ecology of

the virus in its natural host population and identified aspects of the ecology, which required further information. Data were collected from descriptive studies in the field (distribution, contact networks), behavioural observations (personalities), infection experiments in the lab and in the field, manipulating densities of host populations, and investigating infection dynamics in a longitudinal capture recapture study (2009 until now). This work is ongoing. In this talk, I will review the existing knowledge about arenavirus ecology and evolution in African rodents and point out priorities for future research.

**11:45-12:00**

Evolutionary ecology of *Mastomys natalensis*-borne arenaviruses

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The Natal multimammate mouse *Mastomys natalensis* is one of the most successful African small mammals both in terms of its abundance, it being a notorious commensal and agricultural pest, and its distribution, which covers nearly the whole of sub-Saharan Africa. It is also the reservoir host of a wide diversity of arenaviruses: Luna virus (LUNV) in Zambia, Mopeia virus (MOPV) in Zimbabwe, Mozambique and Tanzania, Gairo virus (GAIV) in Tanzania, and most notable Lassa virus (LASV) in several west-African countries. LASV can also infect humans and is causing thousands of hemorrhagic fever cases annually. Countries east of Nigeria seem spared of *M. natalensis*-borne arenavirus infections in human. In this study, we investigate which factors determine the distribution of this wide range of distinct arenaviruses hosted by a single rodent species. Within the range of a single *M. natalensis*-borne arenavirus species, neutral factors such as geographic distance best explain the intraspecies genetic diversity. We show that for MOPV, for which

have a detailed dataset, that neither landscape configuration nor *M. natalensis* population-genetic structure is related to the distribution of the different MOPV genetic strains. In contrast, the distribution of the different arenavirus species is only poorly related to inter-range geographic distance, and is best explained by the spatial distribution of the different *M. natalensis* lineages. Across Africa, there are six intraspecific *M. natalensis* lineages that allopatrically diverged about 1 million years ago. Even though in central Tanzania two of these lineages are in secondary contact, the distributions of their arenaviruses MOPV and GAIV remain strictly bounded by the range of the native *M. natalensis* lineage.

## 12:00-12:15

The effect of pollutant exposure on detoxification organs in an urban adapter, the Banana Bat, foraging at wastewater treatment works

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The Banana Bat, *Neoromicia nana*, is an urban adapter that exploits swarms of pollution-tolerant chironomid midges at wastewater treatment works (WWTWs). We have previously shown that this optimal food resource carries long-term costs from WWTW pollutant exposure, specifically the accumulation of metal pollutants in tissue and sub-lethal haematological and genotoxic responses. However, it is not known if WWTW pollutants are affecting the organs responsible for dealing directly with toxicants. We therefore investigated how pollutant exposure impacts the detoxification organs, namely the liver and kidney of *N. nana* foraging at WWTWs versus unpolluted sites. (i) We quantified metallothionein 1E (MT1E) in the liver and kidney, using western blot analysis. MT1E is a protein produced primarily in the liver and kidney, that protects against metal damage by binding to and detoxifying metal ions, and is generally up regulated in animals exposed to excess metal levels. However, we found that bats at WWTWs had significantly lower MT1E than unpolluted sites. (ii) We performed EDX metal imaging to map the distribution and compositional content of metals in liver and kidney tissue, and preliminary results suggest higher prevalence of cadmium and lead in the tissues of WWTW bats. (iii) Using

hepatosomatic/ renal somatic indices and histological analysis, we found morphometric aberrations in liver and kidneys of WWTW bats. Collectively, our results show that despite the body's innate defense mechanisms against pollutants, *N. nana* populations at WWTWs exhibit negative physiological effects in the detoxification organs. This is indicative of serious damage to their health in response to anthropogenic pollution sources such as WWTWs, which are a common fixture within the urban landscape.

**12:15-12:30**

Rôle des parasites dans le succès d'invasion : Approche corrélative sur deux communautés parasitaires dans le contexte de l'invasion de *Mus musculus domesticus* au Sénégal

\*Christophe Diagne<sup>1</sup>, Lucie Tamisier<sup>2</sup>, Khalilou Bâ<sup>1</sup>, Nathalie Charbonnel<sup>2</sup>, Jean-François Cosson<sup>2</sup>, Ambroise Dalecky<sup>3</sup>, Mamoudou Diallo<sup>1</sup>, Maxime Galan<sup>2</sup>, Philippe Gauthier<sup>2</sup>, Jean-François Martin<sup>2</sup>, Alexis Ribas<sup>2</sup>, Caroline Tatard<sup>2</sup> et Carine Brouat<sup>2</sup>

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Le parasitisme est au centre de trois hypothèses majeures visant à expliquer le succès des invasions. Ces trois hypothèses sont : (1) la perte des ennemis naturels par les hôtes invasives (« enemy release », ER) ; (2) l'introduction de parasites exotiques par les hôtes invasifs au détriment des natifs (« spill-over », SO) ; (3) l'amplification des cycles des parasites natifs par les hôtes invasifs (« spill-back », SB). Nous nous intéressons à une invasion actuellement en cours au Sénégal, impliquant une espèce envahissante majeure : la souris domestique *Mus musculus domesticus*. Nous cherchons à évaluer le rôle du parasitisme sur le succès de la souris, en développant des analyses comparatives des

structures de communautés parasitaires des rongeurs invasifs et natifs. Notre approche se base sur un échantillonnage de localités du Sénégal choisies sur un gradient d'invasion. Deux communautés de parasites ont été étudiées sur les rongeurs échantillonnés : les helminthes intestinaux, et les bactéries pathogènes de la rate. La détermination des parasites/pathogènes a été réalisée avec des outils morphologiques (helminthes) et moléculaires (helminthes, bactéries). Les attendus des hypothèses ER, SO, SB ont été testés sur la richesse des communautés et la prévalence ou l'abondance des taxons de parasites dominants, avec des modèles linéaires généralisés et des approches multivariées. Nos premiers résultats montrent des patrons parasitaires parfois compatibles avec l'hypothèse ER, mais surtout une variation des structures des communautés sur le gradient d'invasion en général plus complexe qu'attendu.

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**Thursday, 16 April 2015**

**Plenary III**

**8:30-9:00**

**Bat refugia and their cryptic diversity**

Wiesław Bogdanowicz

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Refugia may be treated as an ark where many species find sanctuary from surrounding biota in which they could no longer survive, and where they are able to persist during a time of change. The Iberian, Apennine and Balkan peninsulas in southern Europe acted as refugia of genetic diversity during the glacial peaks of Pleistocene climate oscillations. In the case of bats, these refugia contributed to the development of several new lineages and served as centers for postglacial recolonization of the continent. Areas of refuge have also been documented for David's myotis (*Myotis davidii*) and the greater horseshoe bat (*Rhinolophus ferrumequinum*) in eastern continental Asia, and for the little brown bat (*Myotis lucifugus*) in today's southeastern USA. In Africa, Late Pleistocene and Holocene refugia are hypothesized to have existed along the Atlantic coast of western Africa for several plants and rodents. Similar refugia have been detected in other parts of the African

continent, for non-flying mammals inhabiting forest or savannah. However, bats have been largely neglected from these African refugia analyses. A few exceptions include a recent molecular analysis of bats in Senegal, which revealed exciting and unexpected diversity, suggesting that West Africa was also a "refugium" during the last Ice Age. Important biogeographical affinities among bats have also been observed in southern Africa, and between North Africa and Europe, indicating underestimated biogeographic hotspots with more species to discover. This diversification in sedentary bats may have been driven through the generation of *in situ* adaptations, specialization and niche differentiation, while the emergence of species with a tramp strategy *sensu* Diamond could have entailed the utilization of faunal drift and taxon cycle. Regarding the considerable complexity of species responses to Pleistocene climate oscillations, more research should be undertaken, which may also help to reveal cases of reticulate evolution and sex-biased dispersal.

## Oral presentations

### Session: Bats – different facts of recent research

9:00-9:15

Cryptic diversity in Commerson's leaf-nosed bat (Chiroptera: Hipposideridae) in the western dry forests of Madagascar

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The Commerson's leaf-nosed bat (*Hipposideros commersoni*) is endemic to Madagascar and is particularly common in the western regions of the island in forested areas from sea level to 1150 m. Extensive exploitation for bush meat is probably the most important driver of the species' decline. Seasonal variation in abundance has been noted, but it is not clear if the species undergoes a form of torpor or whether they are partially migratory. A previous study on

patterns of morphological variation highlighted the presence of two distinct morphotypes: larger individuals in the north with small individuals in the south. The main aim of this study was to reanalyse the craniodental data and complement this with molecular data from both mitochondrial and nuclear genes. Phylogenetic analyses suggest that *H. commersoni* is not monophyletic, with strong support from the molecular data for the presence of several deeply divergent lineages. Two individuals sampled from Isalo (south central) and Itampolo (southwest) are sister to a clade containing *H. vittatus* and *H. gigas* and other *H. commersoni* specimens. Within the *H. commersoni* *sensu stricto* clade, the molecular data support two geographically correlated clades: a northern group and a more largely distributed southern group. The molecular clock analyses suggested that these two clades diverged approximately 4.39 million years ago. Morphometric data are mostly consistent with the molecular data suggesting a north-south break. However, at some localities these two clades co-occur with individuals from these two genetically distinct genetic lineages showing convergence in external and craniodental morphology. This study highlights the utility of the combined approach in which both morphological and molecular data provide important information of the evolution of widespread taxa on Madagascar.

**9:15-9:30**

The ecology of Malagasy bats: Progress and challenges

Béza Ramasindrazana<sup>1,2,3</sup>, Claude Fabienne Rakotondramanana<sup>3,4</sup>, Pablo Tortosa<sup>1,5</sup>, Koussay Dellagi<sup>1,2</sup> and Steven M. Goodman<sup>3,6</sup>

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The key function of bats in the balance of natural ecosystem has been extensively documented and the importance of frugivorous taxa in seed dispersal and plant pollination, as well as the role of animalivorous species in the regulation of insect populations is now widely accepted. On Madagascar, the investigation on bats has thus far primarily focused on taxonomical aspects, and several decades of intensive sampling have provided considerable advances in the knowledge of this highly endemic fauna. These studies mainly based on morphological and molecular tools led to the current recognition of 44 species on the island belonging to eight families, amongst which several cryptic species have been recently described. Additionally, bioacoustic studies on these different species were also conducted for species identification and ecological purposes. Echolocation calls are generally species-specific, and, depending on the studied groups, can be used in species identification and constitutes a key for bioecological studies. Moreover, different recent studies have provided new insights into the ecology of these nocturnal mammals, specifically, the distribution, diet as well as major threats of Malagasy bat fauna. These results are not only important for future conservation programs or for a sustainable exploitation of this resource (bush meat and guano), but are also of major significance for understanding the ecology of bat-hosted pathogens that are currently showing increasing interest. Investigating the dynamics of bats parasites in the wild requires a comprehensive knowledge of bats ecology notably social behavior, natural history or populations structuring. Madagascar shelters a diverse and mostly endemic bat fauna for which taxonomy and distribution is now well established. This somehow unique situation offers outstanding opportunities to Malagasy bat biologists who can actively participate to multidisciplinary research programs aiming at understanding the ecology of bats and their pathogens.

**9:30-9:45**

Effects of forest fragmentation on bats at Kakamega Forest, western Kenya

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Habitat loss and fragmentation are serious threats to biodiversity, especially in tropical rainforests, with arguably highest biodiversity, but where deforestation is continuing at an alarming rate. Nonetheless, little is known about such perturbations on biotas. We investigated effects of forest degradation and fragmentation on the relative abundance of bat species and community composition at Kakamega Forest, western Kenya, based on captures at two locations (edge and interior) at 36 sites in three forest fragments of differing sizes and fragment characteristics (fragment size, tree density (DBH > 20 cm) and degree of degradation (indexed as density of stumps in each fragment, and measure of forest cover). A total of 1296 mist-net hours and 1786 harp-trap hours (in 72 nights) resulted in the capture of 4430 bats representing 16 species and seven families. Frugivores had significantly higher abundances on the edges of the larger Main Kakamega Forest fragment (8600 ha) than on the edges of the smaller Malava Forest fragment (100 ha). Similarly, highly cluttered or narrow space animalivores (presumably "forest specialists") predominated in the forest interior of the Main Kakamega Forest than in the smaller Malava Forest. Canonical Correspondence Analysis (CCA) showed that forest cover and tree density explained the occurrence of many forest specialists in the forest interior while frugivores were associated with stump density. We thus infer that the highly disturbed and open Malava Forest fragment, with the least and highest tree and stump density, respectively, favoured species that occur in open habitats or on the edges. Conversely, specialist species almost exclusively occurred in the less disturbed, larger and closed canopy Main Kakamega Forest, and may prove especially vulnerable to forest fragmentation.

9:45-10:00

*Nycteria* parasite coevolution with African rhinolophid and nycterid bats

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Parasitic protozoa have evolved many co-evolutionary paths towards stable transmission to their host population. *Plasmodium*, the causative agent of malaria, and related hemosporidian parasites are arthropod-borne eukaryotic pathogens that actively invade and develop within erythrocytes, often resulting in substantial morbidity and mortality of the infected hosts. Across this parasite family, a diverse intermediate hosts are used, including several orders of mammals, birds, squamate reptiles, turtles, and crocodilians. Bats have been known to be hosts of malaria parasites for over a century, and as hosts, they possess perhaps the most phylogenetically diverse set of hemosporidian genera and species. We present the first detailed molecular phylogenetic analysis of the hemosporidian genus *Nycteria*, a parasite of tropical insectivorous bats. A hallmark of these parasites is their capacity to infect several distinct families (Rhinolophidae, Hipposideridae, Megadermatidae, Emballonuridae, and Nycteridae) of the two evolutionary distant suborders of chiropteran hosts. We detected parasites in rhinolophid and nycterid hosts in geographically separate areas of sub-Saharan Africa (Sierra Leone, South Sudan, and Kenya) and show that molecular phylogeny supports distinct clades of *Nycteria* according to the two

host genera *Nycteris* and *Rhinolophus*, suggestive of ancient co-divergence and low-levels of host switching. This hemosporidian parasite-mammalian host system highlights that benign infection without erythrocytic replication and its associated pathology is a successful alternative to virulence.

**10:00-10:15**

Is interspecific competition for private frequency bands implicated in signal divergence in mammals?

David S. Jacobs and Anna C. Bastian

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Central to Darwin's theory of evolution by natural selection is the idea that competition is one of the processes that causes lineage divergence. Competition is now pervasive in explanations of such divergence and is often invoked as an ad hoc explanation for differences between species occupying the same habitat. This raises the spectre of Connell's "ghost of competition past". Evidence for competition amongst mammals has most often focused on traits (e.g. diet) not usually associated with mate choice or sexual selection, processes that can lead to divergence. Little work has been done on competition for acoustic signal space, despite the potential for such signals to mediate mate choice and non-random mating. There is much evidence, at least for birds and frogs, that communication signals can drive divergence and that in multi-species assemblages competition results in species using divergent acoustic signals to promote species specificity. We used horseshoe bats (*Rhinolophus*) as a test case to investigate the role of interspecific competition in driving divergence in acoustic signals. We compared the call frequencies of several species of bats in allopatry and sympatry and found patterns of frequency variation within species that were strongly suggestive of divergence mediated by interspecific competition. In all multispecies assemblages, no two species had overlapping call frequencies and populations within species used different call frequency in allopatry and sympatry. In sympatry, *R. blasii* and *R. clivosus* called at 87 kHz and 92 kHz, respectively. However, in allopatry *R. blasii* called at 92 kHz. Similarly, in sympatry with *R. blasii* (87 kHz), *R. simulator* called at

80 kHz and in allopatry at 86 kHz. Lastly, *R. capensis* in sympatry with *R. damarensis* (86 kHz) called at 78 kHz and in allopatry at 86 kHz.

**10:15-10:30**

Listening carefully: Increased perceptual acuity for species discrimination in multispecies signalling assemblages

Anna Bastian and David S. Jacobs

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Communication is a fundamental component of evolutionary change because of its role in mate choice and sexual selection. Acoustic signals are vital elements of animal communication and sympatric species may use private frequency bands to facilitate intraspecific communication and identification of conspecifics (acoustic communication hypothesis, ACH). If so, animals should show increasing rates of misclassification with increasing overlap in frequency between their own calls and those used by sympatric heterospecifics. We tested this on the echolocation of the horseshoe bat, *Rhinolophus capensis*, using a classical habituation-dishabituation-experiment in which we exposed *R. capensis* from two phonetic populations to echolocation calls of sympatric and allopatric horseshoe bat species (*R. clivosus* and *R. damarensis*) and different phonetic populations of *R. capensis*. As predicted by the ACH, *R. capensis* from both test populations were able to discriminate between their own calls and calls of the respective sympatric horseshoe bat species. However, only bats from one test population were able to discriminate between calls of allopatric heterospecifics and their own population when both were using the same frequency. The local acoustic signalling assemblages (ensemble of signals from sympatric conspecifics and heterospecifics) of the two populations differed in complexity as a result of contact with other phonetic populations and sympatric heterospecifics. We therefore propose that a hierarchy of discrimination ability has evolved within the same species. Frequency alone may be sufficient to assess species membership in relatively simple acoustic assemblages but the ability to use additional acoustic cues may have evolved in more complex

acoustic assemblages to circumvent misidentifications because of the use of overlapping signals. When the acoustic signal design is under strong constraints because of dual functions and the available acoustic space is limited because of co-occurring species, species discrimination is mediated through improved sensory acuity in the receiver.

### **Session: Humans, agriculture, and introduced mammals**

**11:00-11:15**

The StopRats project: The next step in delivering ecologically-based rodent management in Africa

S. R. Belmain<sup>1</sup>, P. R. Brown<sup>2</sup>, R. Davies<sup>3</sup>, S. J. Eiseb<sup>4</sup>, S. M. Goodman<sup>5,6</sup>, F. Kirsten<sup>7</sup>, H. Leirs<sup>8</sup>, T. Mahlaba<sup>9</sup>, R. H. Makundi<sup>10</sup>, E. von Maltitz<sup>7</sup>, P. Malebane<sup>7</sup>, A. W. Massawe<sup>10</sup>, A. Monadjem<sup>9</sup>, L. S. Mulungu<sup>10</sup>, G. R. Singleton<sup>11</sup>, V. Soarimalala<sup>6</sup>, L. Swanepoel<sup>12</sup> and P. J. Taylor<sup>12</sup>

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The StopRats project (Sustainable Technologies to Overcome Pest Rodents in Africa Through Science) is a new project funded by the European Union to bring together Afro-Malagasy rodent experts to strengthen science, technology and innovation on ecologically-based rodent management as a key enabler for poverty reduction, growth and socio-economic development. StopRats aims to link researchers across Africa and to develop their wider networks with civil society organisations, businesses and policy makers in order to evaluate relevant national/regional policies on rodent management, build capacity in staff and institutions, and increase awareness about rodents, the problems they cause and their ecologically-based management. Research and demonstration activities on the predatory impacts of small carnivores, the use of trapping and trap barrier systems to reduce rodent numbers and hermetic storage to manage post-harvest losses from rodents are to be evaluated. Based on training models used in Madagascar, regional field biology schools will be established in West, East and southern Africa to increase skills of post-graduate students and early career researchers in order to inspire a new generation of rodent experts. StopRats research to document indigenous rodent management practices in the target countries of Namibia, Madagascar, Sierra Leone, South Africa, Swaziland and Tanzania will be presented.

11:15-11:30

Effects of different land use practices on the diversity and abundance of small mammals in Namibia, with special focus on the bushveld gerbil

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We investigated the influence of different land use types on the diversity and abundance of small mammal communities under different climatic conditions in Namibia. Capture mark-recapture studies were conducted on adjacent study sites (each 1-2 ha) in the south (Nama Karoo) and in the north (Etosha region) of the country, whereby the respective study sites represented different land use practices. In the south, diversity parameters of small mammal communities were measured by comparing (moderate) rotational karakul sheep grazing versus uncontrolled goat/donkey grazing. In the north, we compared small mammal communities of a game farm with (moderate) grazing by large herbivores with those of a cattle farm. In total, 584 individuals were caught during 8960 trap nights. Our results show remarkable differences in the small mammal community structure when comparing different grazing regimes. Both studies demonstrate that species richness, abundance and species diversity is considerably higher on the moderately grazed sites, respectively. In the south, on the karakul sheep farming area we found twice as many individuals compared to the goat/donkey grazing area; on the game farming area in the north, we found even four times more individuals compared to the cattle farm. Furthermore, our study highlights certain aspects of the population ecology of the bushveld gerbil (*Gerbilliscus leucogaster*), a largely unknown grassland species, which was abundant in both study regions and obviously responded sensitive to grazing. We propose that specific parameters, such as occurrence, diversity, abundance, and body condition of small mammals reflect anthropogenic

disturbances even under different climatic conditions and that small mammals may thus be used as indicators for sustainable land use, especially in arid and semiarid regions.

**11:30-11:45**

Assessing the impacts of large scale commercial agriculture on the activity and community composition of insectivorous bats in an African savanna, Swaziland

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Intensive agricultural practices such as sugarcane plantations can decrease biodiversity on a landscape scale. However, these plantations can also provide important foraging sites for some species of African bats such as *Chaerephon pumilus* and *Mops condylurus* (Molossidae). Such species are typically open-air foragers (with narrow bandwidth, low frequency, and low duty cycle calls). Nonetheless, we only have a limited understanding of how intensive agricultural practices influence bat communities. This study investigated the effect of sugarcane cultivation on the entire bat community. Our goal was to understand how different species of bats were affected by the abrupt interference of savanna and agro-ecosystem (specifically sugarcane) habitats. Bats were categorized into broad foraging groups based on their echolocation call structure (Molossidae / Emballonuridae: open-air; Vespertilionidae / Miniopteridae: clutter-edge; and Hipposideridae / Rhinolophidae; clutter). To measure bat activity we established six grids (each 25 ha in extent) randomly located in savanna and sugarcane habitats. At each grid, we placed nine detectors 125 m apart. We recorded bat echolocation calls using ANABAT II and ANABAT Express detectors. Detectors were placed out before dusk and collected the following morning after dawn. We made recordings six times (three in summer and three in winter) over a one-year period. Activity was calculated as the number of passes recorded. We used a reference call library based on bats captured in the study site for call identification. Where

complete separation could not be attained, the species with overlapping calls were treated as a single "acoustic species". Bat species richness was highest in the savanna and decreased significantly in the sugar cane plantations. In contrast, bat activity appeared to have the opposite trend, with higher activity in sugarcane plantations. This study has shown that sugarcane fields have significant impacts on the structure of savanna bat communities by decreasing species richness, and altering bat activity patterns.

### 11:45-12:00

Variations in small mammal distribution, abundance and diversity under shifting cultivation agricultural practices in the north-eastern Tanzania

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A capture-mark-release study was carried out from July 2012 to February 2014 to investigate the impact of shifting cultivation on small mammal ecology in northeastern Tanzania. We hypothesized that while small mammal abundance, composition and diversity remain stable in less disturbed areas, these variables will change with the level of disturbance due to shifting cultivation. Four permanent grids measuring 70 x 70 m were set in four different habitats with various levels of disturbance due to shifting cultivation. A total of 574 individual small mammals were captured in 7644 trap nights giving a trap success of 7.5%. Eight rodent species (*Mastomys natalensis*, *Acomys spinosissimus*, *Lemniscomys griselda*, *Gerbilliscus leucogaster*, *Aethomys chrysophilus*, *Grammomys dolichurus*, *Rattus rattus*, *Mus minutoides*) and two

insectivores (*Crocidura*, *Petrodromus tetradactylus*) were captured during the study period. *Mastomys natalensis* was the dominant small mammal while *R. rattus* and *Mus minutoides* were the least abundant. Significant variation in species composition, diversity, richness, and distribution and population abundance were observed across the four habitats. Our results show some local impact of agricultural activity on rodent densities, species diversity and richness in the study area. It was observed that not all the species showed high habitat adaptation in a changing environment. *Mastomys natalensis*, however, had high densities in all the habitats indicating a broader habitat tolerance. From the current study, it is obvious that small mammal population abundance, composition, diversity and distribution are largely affected by human activities especially the shifting cultivation type of agriculture.

## 12:00-12:15

To what extent are three types of deterring means efficient to control the loss of litchi crops consumed by Madagascar fruit bats?

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All the three fruit bats on Madagascar (*Pteropus rufus*, *Eidolon dupreanum* and *Rousettus madagascariensis*) are endemics and there is evidence that they fed on litchi crops. Our study was conducted in Anosibe An'Ala (center east) and Tolagnaro (extreme southeast) in 2012-2013 during the litchi harvest period and focused on *P. rufus* and *R. madagascariensis*. Two of our three methods were inspired from those used by the litchi growers in Tolagnaro, where the use of sound (iron bell) and vision (scarecrow) deter fruit bats from eating fruits. We improved upon these techniques and standardized them to avoid complications with our statistical analyses. The third method was for biological control with a product known as "Plantskydd"; its taste and odor is supposed to deter bats. The litchi fruit damage by fruit bats per standing tree ranged from 440 g to 7040 g and two of our three methods seemed to be efficient

to reduce deprivations by bats. Plantskydd is produced in the USA, and made from dried mammal blood and vegetable oil. There were significant differences in the damage levels between the study sites and between our three deterring methods. The scarecrow and bell ringing methods seemed to have greater effect to reduce the fruit bat damage. The effectiveness of the biological product (Plantskydd) was apparent if the product was pulverized, had enough time to dry, and adhere to fruit before rain. Results from the fecal samples showed that fruits bats had no clear dietary preferences, but choice was influenced by food availability.

### 12:15-12:30

Les mesures de mitigation sur les petits mammifères dans le site minier d'Ambatovy : Activités et résultats

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Ambatovy est un grand projet minier d'exploitation de nickel et cobalt à ciel ouvert dans la forêt orientale de Madagascar. Sa localisation est connue dans une région à des niveaux élevés de biodiversité. En respectant ses engagements environnementaux, Ambatovy applique le processus de la hiérarchie de mitigation en tenant compte de la catégorisation de l'IUCN et les critères de l'IFC (« International Finance Corporation ») sur le critère de Performance 6. Pour la gestion des petits mammifères, les mesures adoptées sont au niveau des zones de défrichement et celles de la zone de conservation. L'objectif est de minimiser les impacts négatifs de la mine sur la population des petits mammifères afin d'analyser l'efficacité de conservation en vue d'une amélioration continue de la gestion de petits mammifères dans le site minier d'Ambatovy. Les approches « coupe lente unidirectionnelle » pour une libre migration

et/ou le sauvetage manuel ont été appliquées pendant les défrichements et renforcées avec deux différents types de piégeage et des observations directes avant défrichement. Durant l'inventaire avant défrichement, 26 espèces ont été observées dont 21 endémiques avec une espèce en danger, 20 préoccupations mineures et 5 introduites. Pendant les défrichements, 3 espèces endémiques ont été sauvées manuellement et transférées vers la zone de conservation. Le nombre des individus observés et sauvés par types d'habitat ainsi que toutes sortes de risques ou changement de comportement lors du défrichement sont évalués pour minimiser les impacts. L'évaluation de l'efficacité de la mesure de mitigation des petits mammifères dans le site minier d'Ambatovy est en cours de réalisation.

## 12:30-12:45

Population dynamics and breeding patterns in two maize cropping calendars in eastern Tanzania

Loth S. Mulungu<sup>1</sup>, Georgies F. Mgode<sup>1</sup>, Victoria Ngowo<sup>2</sup>, Mashaka E. Mdangi<sup>3,4</sup>, Happy Lopa<sup>2</sup> and Bukheti S. Kilonzo<sup>1</sup>

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Rodent pest species are the most important vertebrate pests in Tanzania. This study investigated the population dynamics and breeding patterns of the common rodent pest species in two maize cropping systems in Eastern Tanzania. *Mastomys natalensis* was the most abundant rodent pest species in the study area while others were found in small proportions. Although populations in the study area varied in different months, the highest population density was observed in maize fields and *M. natalensis* was sexually active from January to August, thus suggesting that breeding of this species in a two cropping calendar area extends for longer periods

than in one cropping calendar areas where the same species are sexually active from April to September. Effective and sustainable control operations including farm hygiene and use of traps should therefore be carried out before January in order to keep the pest populations low.

## **Plenary IV**

**14:30-15:00**

Community ecology of small mammals in the 21<sup>st</sup> Century: Trends and prospects

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Community ecology investigates the set of species co-occurring at a given time and place, their origins, and their ecological and evolutionary consequences. Given the rate of habitat destruction world wide, understanding how communities assemble and the factors that influence their dynamics will prove critical to managing and restoring small mammal biodiversity. The increasing availability of phylogenetic and broad-scale environmental data, as well as computing power has helped to reveal the multitude of processes driving community assembly, particularly within macroecological and evolutionary ecology frameworks. In this presentation, I will review previous and ongoing research on patterns and processes of African and Malagasy bat diversity at various spatio-temporal scales, and argue that mechanistic insights into bat community structure and dynamics can be obtained by explicitly incorporating information regarding phylogenetic relatedness, and Grinnellian and Eltonian niches of species. These methods also hold the promise to provide a framework for identifying the species most vulnerable to habitat loss and climate change, and those more likely to maintain gene flow across fragmented landscapes, and persist, despite rapid environmental change.

## Oral presentations

### Session: Small mammal community ecology

15:00-15:15

Forty years of monitoring rodent community and population dynamics at the Sahelo-Sudanian site of Bandia (Senegal): What has really changed?

Laurent Granjon<sup>1</sup>, Khalilou Bâ<sup>2</sup>, Laurent Crespin<sup>3,4</sup>, Ndathie Diouf<sup>2</sup>, Jean Le Fur<sup>1</sup>, Youssoupha Niang<sup>2</sup> and Jean-Marc Duplantier<sup>1</sup>

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The Sahelo-Sudanian community of rodents has been monitored regularly over the last 40 years at Bandia, in the central-western part of Senegal. This formerly "classified forest" became a private faunal reserve in the 1990s. It is characterized by a typical tree savanna growing under a markedly seasonal climate regime with a long dry season (November-June) and a short rainy season (July-October) during which highly variable yearly rainfall have been recorded along the study period. There, using capture-mark-recapture protocols on trapping grids and removal trapping procedures on traplines, small mammals have been studied during five distinct 2-5 year periods in the 1970s, 1980s, 1990s and 2000s. The corresponding data are gathered and analyzed in two ways: i) check for possible changes in the rodent community by comparing the characteristics of the species assemblage during each period; ii) examine details of populations characteristics of the dominant species *Mastomys erythroleucus* (abundance/density, survival, population structure...). Community analyses show that some changes have occurred in term of presence, absence and relative importance of some component species over the years. Analyses focusing on *M.*

*erythroleucus* reveal that fundamental aspects of the species population dynamics remain unchanged, while some particular components showed slight modifications over the decades. These changes are discussed in the light of environmental and climatic shifts that have occurred during the study period. They confirm the utility of rodents as environmental indicators of global changes in the Sahelian area.

### 15:15-15:30

Environmental factors driving lineage diversification in small mammals: A review

\*Gregory Mutumi and David Jacobs

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Environmental factors (climate and geography) drive lineage diversifications in animals. It has been acknowledged in many studies that the degree of interbreeding between populations is affected by both distance and different environmental conditions, i.e., isolation by distance (IBD) and isolation by ecology (ISE), respectively. Adaptation to local environmental conditions and geographic distance affect mate choice across populations and thereby potentially leading to lineage diversification. Environmental variation has therefore been suggested to play a key role in population divergence, despite other competing hypotheses of neutrality, which argue that divergence is largely due to mutations and drift. Even so, for drift to be strong, the environment has to play a role of either separating populations or to make populations different enough to reduce gene flow. The relative contributions of IBD and ISE are therefore poorly understood owing to the difficulty in teasing the two apart. For instance, several studies reveal support for sexual selection in acoustic divergence, but the relative influences of ecological context are not well explored. We propose a framework for teasing apart the relative contributions of adaptive and neutral mechanisms leading to population divergence with a particular focus on acoustic signals in African bats. We also discuss cases where these processes may lead to lineage diversification, and how their relative importance can vary over evolutionary timescales.

Diversité du comportement alimentaire des Vespertilioninae au sein d'un assemblage de chauves-souris insectivores : cas de la concession forestière de Kirindy CNFEREF et de la forêt d'Antsahabe à Madagascar

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Suite à des résultats d'inventaire antérieurs et associés à cette étude, trois espèces affiliées au Vespertilioninae sont connues dans la forêt sèche de Kirindy CNFEREF, *Pipistrellus raceyi*, *P. hesperidus* et *Hypsugo* sp. nov. Cette dernière étant une révision de *H. anchietae* auparavant localisée dans la partie occidentale de Madagascar et également connue dans le continent africain. Dans la forêt humide d'Antsahabe, *Neoromicia matroka* et *N. robertsi* vivent en sympatrie. Les petites espèces de Vespertilioninae sont dotées d'une particularité cryptique et leur similarité morphologique est remarquable, tant entre les espèces de Madagascar qu'Afro-Malagasy. Aussi, décrypter la diversité écologique potentielle au sein de leur communauté a été révélateur. Des investigations orientées sur leur comportement alimentaire ont permis de mieux évaluer des cas de variations interspécifiques, et par la même occasion, d'en savoir davantage sur la diversité, la distribution et la co-occurrence de leurs proies. Ces études ont été essentiellement basées sur la méthode classique d'observation et d'identification sous loupe binoculaire des échantillons d'arthropodes, collectés à l'aide de piège malaise ainsi que de la détermination des restes non digérés dans les pelotes fécales des chauves-souris. A travers des analyses comparatives, suivant les principes des modèles nuls ou à l'aide des estimateurs d'indice écologique, nous présentons des informations sur les niches alimentaires des petites espèces de Vespertilioninae au sein de l'assemblage de chauves-souris insectivores partageant le même biotope avec ce groupe. Ainsi,

l'importance d'un type de proie pour chaque espèce, leur degré de spécialisation et la taille de leur niche alimentaire ont été décortiqués. Ces facteurs étant conditionnés par des contraintes morphologiques, géographiques et même bioacoustiques, diverses hypothèses à inférence écomorphologique ont permis d'expliquer ou d'évoquer une probable répartition ou partage de niche vis-à-vis de la coexistence des espèces sympatriques.

### **Session: Small mammal distribution, diversity patterns, and community ecology**

**16:15-16:30**

Elevational distribution and biogeography of shrews and rodents on Tanzanian mountains

**\*William T. Stanley**

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The mountains of Tanzania are renowned for the biodiversity contained within associated montane habitats, with many endemic species. These massifs are classified into four categories based on geologic origin, including The Northern Highlands, the Eastern Arc Mountains, the Southern Highlands, and mountains in the western part of the country, such as Mahale, that are associated with the Albertine Rift. While these mountains have been the subject of study for over a century, the natural history of some vertebrate groups, such as montane small mammals (shrews and rodents) remain poorly known. Recent detailed faunal surveys and subsequent analyses based on voucher specimens have increased our understanding of the elevational distribution of small mammals on select massifs within Tanzania, and different patterns among these mountains. For example, Mt. Meru exhibits significantly reduced species diversity, but twice the mammal abundance than either nearby Mt. Kilimanjaro or the Udzungwa Mountains of the Eastern Arc. Endemic shrews on the Northern Highland mountains are more widely distributed along elevational gradients, than those of the Udzungwa Mountains. These studies have also increased insights into the biogeography of montane shrews and rodents across Tanzania. For example, the distributions of two different murine rodent genera (*Praomys* and *Hylomyscus*) differ in relation to the Makambako Gap, a purported biogeographical barrier that lies

between the Eastern Arc and the Southern Highlands. In general, soricomorph shrews exhibit greater species diversity and levels of endemism than murine rodents living in the same habitats. Newly discovered shrews show affinities with taxa from various regions of the African continent, and these patterns suggest multiple historic biogeographic influences on this unique fauna.

**16:30-16:45**

Small mammals diversity in Mount Hoyo (eastern DR Congo)

P. K. Kaleme<sup>1,2</sup>, J. M. Mwanga<sup>1</sup> and B. J. Van Vurren<sup>2</sup>

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Mount Hoyo is a forest reserve gazetted in 1937. It is known for its famous caves where thousands of bats roost. The site is located toward the northern end of the Albertine Rift that has been identified as a “biodiversity hotspot”, an “ecoregion” and an “endemic bird area” or as an area of global importance for conservation because it contains many endemic and threatened species. However, the reserve has never been surveyed for its biodiversity. Habitats in the reserve are composed of primary and secondary (less degraded) forest. In some parts, there are abandoned palm tree plantations. Mount Hoyo is one of the Albertine Rift sites that is entirely at lowland elevations. In this study, we inventoried small mammals of the reserve using Sherman live traps and pitfall buckets for rodents and mist nets for bats. Larger mammals were also recorded using line transects and reconnaissance routes. Thirty species of small mammals (17 rodents and 13 bats) and 24 species of large mammals were recorded at the site. These species numbers are an under-estimate because only a small fraction was sampled for small mammals. Some species such as *Lophuromys dudu* are reported for the first time far south of its previously recognized area of occurrence. *Malacomys longipes* was only recorded in less disturbed areas while, *Hylomyscus stella*, *Praomys jacksoni* and *Lophuromys aquilus* were recorded irrespective of the level of disturbance. Large mammals comprised among others, the common chimpanzee (*Pan troglodytes*, *Cercopithecus ascanius*, *C. mitis kandt*, *Sycherus*

*caffer* and *Tragelaphus scriptus*. More samples are needed in the site to have a complete list of the species.

### 16:45-17:00

Composition de communauté de rongeurs et types d'habitats à Franceville, Gabon

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Huit cent trente-deux petits mammifères ont été capturés dans la ville de Franceville au Gabon, dont 728 rongeurs de la famille des Muridés et 104 musaraignes. A l'exception du quartier central, l'habitat humain est dispersé dans une mosaïque savane-forêt. La biodiversité des rongeurs est présentée grâce à un piégeage standardisé, effectué dans 6 quartiers, en saison sèche et en saison des pluies durant deux ans (2013-2014). Elle révèle la présence de 8 espèces : *Rattus rattus*, *Mus musculus domesticus*, *Mus nannomys minutoïdes*, *Lemniscomys striatus*, *Lophuromys sikapusi*, *Praomys jacksoni*, *P. misonnei* et *Oenomys hypoxanthus*. Les courbes de raréfaction montrent que l'échantillonnage est exhaustif. Le rat noir s'avère dominant dans l'ensemble des quartiers échantillonnés. Dans le quartier central avec de nombreux commerces et marchés, il représente les 2/3 des effectifs. Il est capturé aussi bien à l'intérieur des maisons qu'autour des habitations dans les herbes et les jardins. Toutefois, il est totalement absent dans les îlots de forêt et de savane rencontrés dans la ville. La souris quant à elle, est présente dans 3 quartiers sur 6 mais elle n'est domine que dans un seul (l'entrée routière la plus importante) à l'intérieur des maisons. Les souris naines africaines sont présentes, surtout dans les maisons, dans tous les quartiers, mais avec un faible effectif. *Lemniscomys striatus*, *Lophuromys sikapusi* et les *Praomys* sont aussi présents partout sauf dans le quartier central.

*Oenomys hypoxanthus* n'est présent que dans 2 quartiers. L'indice de similarité de Morisita-Horn indique une faible différenciation inter-quartiers à l'exception de 2 quartiers périphériques. Nos résultats montrent que la composition des communautés n'est pas corrélée à la distance entre quartiers ni aux types de végétation, ni à la saison de captures. L'abondance du rat noir masque les différences potentielles et indique une invasion bien avancée aux dépens des endémiques.

### 17:00-17:15

Diversité et écologie des petits mammifères dans les habitats forestiers et non forestiers de Moramanga, centre-est de Madagascar

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Des captures de petits mammifères dans les forêts naturelles en dehors des Aires Protégées et dans les villages des Communes Rurales de Moramanga ont eu lieu entre juillet 2013 et septembre 2014. Par le biais des trous-pièges et des pièges standards, 23 espèces de petits mammifères ont été répertoriées dont 15 espèces d'Afrosoricida endémiques, deux espèces de Soricomorpha introduites et six espèces de Rodentia dont trois endémiques et trois introduites. La richesse spécifique est toujours plus élevée dans les milieux forestiers, mais comparée aux autres blocs forestiers environnants ou autre forêt orientale de l'île, cette richesse est plus faible. Une diversité des espèces est plus accentuée pendant la saison des pluies. Cependant, en termes de rendement, les taux de capture sont plus élevés pendant la saison humide pour les Afrosoricida alors que l'inverse est trouvé chez les Rodentia. Le rat noir *Rattus rattus* est présent dans tous les sites avec le plus grand nombre d'individu capturés. Parmi les Afrosoricida, des cas notables concernent des captures de *Microgale majori* et de *M. pusilla* en milieu villageois situé à plus de 3 km à vol d'oiseau d'une forêt naturelle le plus proche. Parmi les Rodentia, toutes les espèces autochtones ne sont rencontrées que dans les forêts naturelles sauf

*Brachyuromys betsileoensis* qui a été capturée près d'un village. Cette étude fournit des analyses qui contribuent à une meilleure compréhension du mode de vie des petits mammifères de la grande île.

**17:15-17:30**

Small mammal succession in the Grassland Biome, South Africa

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The recovery of southern African grassland ecosystems following disturbances remains relatively unstudied. This study investigates changes in small mammal numbers and community structure in relation to vegetation recovery following a range of disturbances, including fire, in central South Africa. The areas studied fall within one of South Africa's most threatened biomes, the Grassland Biome, where fire (for example) is a natural disturbance factor, and plant and faunal communities can be expected to have adapted to this natural disturbance regime. In general, densities and species richness of both vegetation and small mammals decrease with disturbance, conforming to Tilman's curve. Here the Southern multimammate mouse *Mastomys coucha* is a good indicator: this species often do not disappear from stands, even under extreme interference, and dominates small mammal communities during or shortly after disturbance. Much similar to grasses, small mammal species richness and density increase with succession. Some species, such as the Vulnerable white-tailed mouse *Mystromys albicaudatus*, enter and exit small mammal communities at specific stages while specialist species, such as climbing mice *Dendromus* spp., only appears closer to the climax stage. These results confirm the indicator statuses for a number of rodent species. It also adds to findings of earlier studies, suggesting that small mammal communities may be effective indicators of habitat integrity in southern African grassland ecosystems.

Isolated small mammal communities: A scrutiny of the island rule

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Variation in body size of various animal taxa of island populations compared to mainland populations were the focus of numerous studies. The pattern of gigantism in insular marsupials and rodents, and dwarfism amongst carnivores, artiodactyls and lagomorphs, which inhabit islands, was coined as the "island rule". Comparisons between rodent and elephant-shrew populations of a small island, large island and the mainland were examined at the Vanderkloof Dam in the Northern Cape (South Africa) after 40 years of construction. The capture-mark-recapture technique was used to investigate the island rule and to determine species composition and population sizes of such species. Over a period of five days, 135 individuals represented by two species were captured on the large island. The Namaqua rock mouse (*Micaelamys namaquensis*) was the most abundant and represented 91.85% of all individuals caught, while only 11 individuals (8.15%) of the Eastern rock elephant-shrew (*Elephantulus myurus*) were collected on the large island. In comparison, no small mammal was captured on the small island. Although the mainland, represented by four species, proved to be higher in species richness, fewer individuals (27) were caught during the same period. Species caught on the mainland were represented by the Bushveld gerbil (*Gerbilliscus leucogaster*) 44.44%, the Namaqua rock mouse (29.64%), the Cape pouched mouse (*Saccostomus campestris*) 22.22% and the Eastern rock elephant-shrew (3.70%). Gigantism (insular population compared to mainland population) was noted in the Namaqua rock mouse after only 40 years of isolation. A relative body size of 1.26 (insular body weight divided by mainland body weight) was calculated for this species indicating a divergence towards gigantism of this insular population. The decrease in both interspecific competition and predation pressure can be used to explain the observed pattern of gigantism in this species.

17:45-18:00

Local and landscape scale effects on small mammal populations in southern African savannas

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Scale is an important consideration in ecology. We examined impacts on small mammal communities at two scales: local and landscape. At the local scale, we examined the impact of sugarcane plantations on terrestrial small mammals by trapping on randomly located traplines that extended from natural savanna vegetation into the sugarcane (375 m into either habitat). Species richness and heterogeneity was significantly reduced in sugarcane whereas community similarity increased, suggesting a more homogenized small mammal community. Furthermore, the sugarcane plantations created high-density communities of generalist species with species native of intact savannas disappearing in less than 225 m into the sugarcane. From an ecosystem functioning perspective, granivores declined with increasing distance into the sugarcane and were completely absent at 375 m from the boundary while omnivores increased in the sugarcane. Insectivores and herbivores showed no differences between the two land uses. These shifts in small mammal communities have clear implications for ecosystem processes as the removal of granivores may alter vegetative structure. Hence, our results emphasize the need to create or retain natural habitat features in agricultural-savanna mosaics. At the landscape scale, we examined the impact of elephants on terrestrial small mammals by trapping rodents on grids in Kruger National Park, South Africa (elephants present) and Mlawula-Mbuluzi-Hlane reserves, Swaziland (elephants absent). Rodent communities had significantly higher species richness in the absence of elephants. Kruger showed large reductions in heterogeneity of vegetative structure on multiple scales compared with Swazi sites and this reduction in vegetative heterogeneity was correlated with substantial decreases in rodent species richness.

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**Friday, 17 April 2015**

**Plenary V**

**8:30-9:00**

Some genetic consequences of population and social structure

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Most species are spatially and socially organised. However, population geneticists tend to ignore both facts and typically use demographic models that assume random mating over wide geographical areas (*i.e.* they ignore population structure) or over more limited/local areas (*i.e.* they ignore social structure). This is sometimes surprising given that structured models, such as the n-island or the stepping-stone models were actually devised more than sixty years ago. Given that genetic data are increasingly used for the conservation of endangered species, including lemurs and other small mammals, and given that genetic data provide unique information on the recent evolution of populations (population expansions or contractions, time of population split, admixture, etc.), it is important to try and understand how population and social structure should be integrated to help understand the genetics of endangered species. I will present some recent results obtained in our group on the impact of (i) social structure and mating systems on genetic and genotypic diversity of "populations" and (ii) population structure on demographic inference.

## Oral presentations

### **Session: Genetics – phylogeography, phylogeny, and biogeography**

**9:00-9:15**

Comparative phylogeography for five species of Moroccan rodents and shrews

Aude Lalis<sup>1</sup>, Violaine Nicolas<sup>1</sup>, Mohamed Fekhaoui<sup>2</sup>, Ahmed El Hassani<sup>2</sup>, Touria Bennazou<sup>3</sup>, Christiane Denys<sup>1</sup> and François-Joseph Lapointe<sup>4</sup>

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Coastal and central regions of Morocco are characterized by a significant increase of urban areas and tourism involving degradation of natural environments. These anthropogenic stresses and the increase of intensive agriculture in these regions can cause significant damage to the biodiversity of small mammals very subservient to the local environment. To make a statement of some changes in small mammal communities in these areas, we conducted many campaigns trapping as part of the project ANR MOHMIE 2010-2014. Thus, we sampled 17 localities in anthropic and six zones in protected areas. For a total of 6297 trap-nights, we collected 954 specimens belonging to four orders (Erinaceomorpha, Soricomorpha, Rodent, Macroscelidea) and 11 species. We were able to reconstruct the geographic and demographic history in North Africa some species (*Gerbillus campestris*, *Apodemus sylvaticus*, *Meriones shawii*, *Mus spretus*, *Crocidura russula*) by combining genetic and fossil data. The results for two species *Apodemus sylvaticus* and *Meriones shawii*, will be presented as an example. Finally, the comparative phylogeography focused on understanding the spatial patterns of genetics between species having the same

geographical distribution. In the case of species with distinct distributions, it is nevertheless possible to estimate a global scenario using methods for the overall combination of data partially disjoint. We will apply these techniques to five species of small mammals (*Gerbillus campestris*, *Apodemus sylvaticus*, *Meriones shawii*, *Mus spretus*, *Crocidura russula*), specifically coding different models of spatial data. In particular, trees representing different taxa are compared statistically using the method of common subtrees, while the method of the super-tree will be used to build phylogeography regions of Morocco. The results are discussed in the context of biodiversity conservation.

### 9:15-9:30

The phylogeography of the rodent genus *Malacomys* suggests multiple Afrotropical Pleistocene lowland forest refugia

Kouakou Hilaire Bohoussou<sup>1,2</sup>, Raphael Cornette<sup>3</sup>, Bertin Akpatou<sup>1,2</sup>, Marc Colyn<sup>4</sup>, Julian Kerbis Peterhans<sup>5</sup>, Jan Kennis<sup>6,7</sup>, Radim Šumbera<sup>8</sup>, Erik Verheyen<sup>7,9</sup> Eliézer N'Goran<sup>1</sup>, Pionus Katuala<sup>10</sup> and Violaine Nicolas<sup>3</sup>

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This study aims to reconstruct the evolutionary history of the African rodent genus *Malacomys* and to identify factors driving diversification within this genus. Analyses were based on sampling covering the whole geographical range of the genus (tropical lowland forest, from Sierra Leone to Burundi and Zambia). We assessed genetic structure and historical biogeography using a combination of mitochondrial and nuclear markers. Morphological differences between lineages were analysed using a geometric morphometric approach. Three species of *Malacomys* are recognized within the genus. Two are endemic to West Africa, and one is endemic to Central Africa. Our analyses reveal a strong phylogeographical structure, with 13 lineages, most of them being allopatric or parapatric. A complex biogeographical history, including dispersal and vicariance events, explain the current genetic structure of *Malacomys*. Discrete divergence events within the genus are dated to the mid-Pliocene (3.7 Ma) and the Pleistocene. Morphological variation is partly congruent with genetic structure and may indicate local adaptations. To conclude, climatic oscillations in the Pleistocene, which led to periodic fragmentation of the forest habitat, seem to be the major driver of diversification within this genus. Our results support the existence of multiple small forest refugia during glacial maxima, rather than a few large ones. Rivers have played an important role in shaping boundaries of several regional haplogroups, either by promoting diversification or by preventing secondary contact between previously isolated lineages.

#### 9:30-9:45

Comparative phylogeography of the Somali-Maasai savanna in eastern Africa using small rodents as a model

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Somali-Maasai savanna is one of the least known African biogeographic regions; especially information on genetic structure within species or among closely related species is entirely missing from this area. It is therefore very difficult to assess which factors (like Plio-Pleistocene climate fluctuations, geomorphological barriers, etc.) have influenced the evolution of savannah biota in this part of Eastern Africa. Relevant information from well selected model species of free-living organisms can be especially useful for understanding the history of our own species, because numerous crucial localities for studies of human evolution are located just in the Somali-Masai region. Small mammals, and especially rodents, are very suitable model for phylogeographic reconstructions, because they are tightly linked to specific habitat type, have low dispersal ability and relatively high substitution rate of mitochondrial DNA. In the present comparative study, we have analyzed genetic structure of three rodent genera (*Acomys*, *Arvicanthis* and *Gerbilliscus*) typically inhabiting dry savanna of Eastern Africa. Using combination of detailed distributional and genetic data, we were able to propose the scenario of historical changes in the Somali-Maasai region and to identify the most important long-term geographical barriers of gene flow in (e.g. mountain chains, large rivers or paleo-lakes in the Rift Valley, which have played important role in evolution of rodents during Plio-Pleistocene.

9:45-10:00

Phylogeny and taxonomy of the African Rhinopomatidae

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Three rhinopomatid species have been traditionally reported from Africa: *Rhinopoma microphyllum* and *R. hardwickii* with large ranges over the Old World arid zone, and *R. macinnesi* with a limited local range in East Africa. However, recent molecular genetic studies have distinguished the African and West Arabian populations of *R. hardwickii* as a separate species, *R. cystops*, while restricting *R. hardwickii* s.str. to the remaining Asian regions from Iran eastwards. A new species, *R. hadramauticum*, was described as an endemic of the Afro-tropic zone of southern Arabia. Several individuals of *Rhinopoma*, tentatively assigned to *R. cystops* based on external morphology, were caught in southeastern Senegal and northwestern Mauritania. Phylogenetic position of these specimens within *Rhinopoma* was inferred using the mitochondrial cytochrome *b* sequences. Two closely related haplotypes clustered as a deeply divergent evolutionary lineage within an unresolved monophyletic group further comprising *R. cystops* inhabiting area from Morocco up to southern Arabia and *R. hardwickii* s.str. from Iran and India, differing in 7.9–9.1% of uncorrected genetic distance from these two lineages. This endemic West African lineage most likely represents a remainder of an early colonisation of the African continent from Asia. Additional analysis using a shorter sequence dataset showed the endemic *R. macinnesi* as a sister lineage to *R. cystops*, rendering the position of the West African lineage paraphyletic. Given the genetic differentiation from the other lineages of the *R. hardwickii* group, a separate species status should thus be recognised for the respective West African new lineage. Hence, the final number of the Afrotropical species of the family increases to five.

10:00-10:15

Invasion genetics of the black rat and the house mouse in Africa: A legacy of human history?

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Studies focusing on geographical genetic patterns of commensal species and on human history complement each other and provide proxies to trace common dispersal events. In Africa, the unintentional introduction and spread of commensal rodents by people may have left a living clue of human colonization history. During the last few years, we addressed these questions by characterizing the population genetic structure of commensal rodents in different historical and geographical contexts. Here, we present the results obtained on the black rat *Rattus rattus* in Madagascar, and the house mouse *Mus musculus domesticus* in Senegal. Natural populations of rodents were sampled across both countries, and both species were studied using microsatellites and mitochondrial sequences. Data were analysed by a combination of methods using population genetics, phylogeography and approximate Bayesian computation. Our results indicated that few introduction events to Madagascar and Senegal would be at the origin of large spatial expansion in both countries. The inferred timing of introduction events and origin areas are congruent with human history in both countries. In Madagascar, they suggest that the introduction of *R. rattus* was related to the Arabian trade network in the Indian Ocean, which was flourishing from the middle of the first millennium. In Senegal, the house mouse invasion would be related to European colonization events and colonial settlements along the west African coast.

10:15-10:30

Genetic structure of rodents in Zambezian savannah - the role of rivers, mountains and climatic changes

Josef Bryja<sup>1,2</sup>, Vladimir Mazoch<sup>3</sup>, Tatiana Aghová<sup>1,2</sup>, Ondřej Mikula<sup>1,4</sup>, Molly M. McDonough<sup>5</sup> Jan Petružela<sup>2</sup>, Rhodes Makundi<sup>6</sup> and Radim Sumbera<sup>3</sup>

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Zambezian biogeographical region is spreading in a wide belt from Angola to Tanzania and Mozambique and is dominated by savannahs and woodlands. Phylogeographic structure of animals living in this area is only poorly known and limited to few large-sized species of mammals, thus reducing the power of phylogeographical reconstructions. In our study, we used the comparative approach to assess the role of past climate and geomorphology on observed genetic structure of rodents inhabiting Zambezian savannahs. We provide evidence for Pleistocene refugia of savannah-woodland habitats during otherwise unsuitable climatic conditions. Subsequent population expansions were often stopped by large water bodies (e.g. Zambezi, Kafue or Shire Rivers or Lake Malawi) and forested mountains (e.g. Eastern Arc Mountains), which is confirmed by largely concordant spatial genetic structure among different rodent taxa. We also detected several secondary contact zones (e.g. in central Tanzania) that can serve as models for speciation studies and represent important hot-spots also for organisms associated with rodents, e.g. viruses or host-specific parasites.

## **Session: Small carnivores, squirrels, prosimians, and bat physiology**

**11:00-11:15**

Africa's other carnivores: Assessing continent-wide knowledge gaps in small carnivore research

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African small carnivores—terrestrial species with adult body mass < 15 kg—represent about 35% of extant small carnivores worldwide. Eight of the world's nine carnivore families have representative species meeting this criteria in Africa (Canidae: 14% of African small carnivores; Eupleridae: 8%; Felidae: 9%; Herpestidae: 32%; Hyaenidae: 1%; Mustelidae: 12%; Nandiniidae: 1%; and Viverridae: 21%). In spite of this diversity, studies on Africa's larger species, constituting 10 species, seem to dominate carnivore research in this region. In order to both quantify research bias and highlight limited knowledge gaps in our understanding of African carnivores, we undertook a thorough literature review of all published works on African carnivores, both large and small. Using a myriad of sources including recently published compendiums on African mammals (i.e., Mammals of Africa, vol. V), we identified 8,867 published records for all carnivore species including duplicates. Of these, a total of 6,177 papers or more than 69% of all focused on at least one of the 10 large carnivore species, compared to 30% or 2,690 for the remaining 81 small species. Classification of these papers into 14 distinct categories is currently underway to identify particular areas of research ranging from genetics to basic ecology that are lacking for individual species. For small carnivores, a majority of research to date has focused on social mongooses such as the banded mongoose and meerkat. For a majority of Africa's small carnivores, little to no research exists on the fundamental ecology or

conservation status. Our research will help to address specific areas for future research on these little studied, yet ecologically-important species.

### 11:15-11:30

The role of mesocarnivores in ecosystem function in the lowveld of Swaziland

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Mesocarnivores provide ecosystem services by regulating disease, removing carrion, and controlling vermin. Rapid changes in land use regimes can alter the ecosystem sufficiently that ecosystem services like these are impaired. As a first step towards understanding how changes in the landscape influence mesocarnivore community ecology and function, we surveyed mesocarnivores across different land use types in the lowveld of Swaziland. We compared the rate and duration of visitation and identity of visitors to baited camera traps across four land use types: protected areas, sugar cane, modern settlements, and traditional settlements. Initial results show that generalist species such as jackals occurred in almost all habitat types except traditional villages. We also found that domestic carnivores (dogs and cats) dominated bait stations in modern and traditional settlements, and genets, bush pigs, raptors and vultures occurred only in protected areas or sugar cane near protected areas. Future analyses will focus on diet analysis of generalist mesocarnivores across these habitat types to understand their role in the local food web.

### 11:30-11:45

Conservation challenges, rarity and knowledge gaps for the squirrels of Africa

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Africa is well known for the charismatic megafauna that are emblematic. The conservation status of large mammal species is often well documented resulting in considerable scientific and public attention. Such efforts are important and laudable; however, the conservation status of small less well recognized species is often poorly known. Assessing the conservation challenges faced by small mammals is important; however, the task is hampered by the fact that significant numbers of these mammalian microfauna are considered to be data deficient. Through surveys of published literature on small mammals, the gaps in our knowledge and understanding are apparent and considerable. Taxonomic bias towards carnivores and ungulates and a positive association with body size is evident in the published literature. Squirrels (Rodentia: Sciuridae) represent a widespread group across the continent that are diurnal and conspicuous relative to other small mammals but demonstrate a similar dearth of knowledge. Assessment of squirrel distributions, habitat quality and socioeconomic factors suggests that centers of diversity are located in areas experiencing the most rapid change and thus threats of loss are likely high. Identification of species at greatest risk by such assessments can provide important insight into the conservation status of and planning for our charismatic microfauna.

## 11:45-12:00

Reproductive activity and its endocrine correlates in the African lesser bushbaby, *Galago moholi*

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The African lesser bushbaby, *Galago moholi* is a small nocturnal prosimian commonly found throughout southern Africa. Despite its wide distribution and common appearance only limited data on the reproductive activity pattern and its endocrine correlates exist for the species. To characterize the endocrine pattern in relation to key reproductive events, seven captive mating pairs as well as individuals of a surrounding free-roaming population were monitored for 10 months at the Primate Sanctuary, Buffelsdrift, South Africa. In addition to frequent behavioural observations and physical measurements, faeces were collected for non-invasive endocrine monitoring three times a week from captive individuals and whenever free-ranging individuals were caught. Our data demonstrate that the two identified periods of male sexual activity are associated with an increase in testis size as well as elevated faecal androgen metabolite levels. Five of the seven paired females showed frequent ovarian cycles (follicular phase,  $4.4 \pm 1$  days; luteal phase,  $5.3 \pm 1.9$  days) and became pregnant during either the first (around May,  $n = 4$ ) or the second mating period (around September,  $n = 1$ ). Faecal progestagen and estrogen metabolite levels remained above individual hormone baseline levels until parturition (gestation period,  $128 \pm SD 3.3$  days). In males, faecal glucocorticoid metabolite (fGCM) levels, as an indicator of stress, were elevated during periods of reproductive activity. For females, however, fGCM concentrations seem to increase over the course of pregnancy. The revealed cross-sectional hormone data for the wild *G. moholi* population confirm the endocrine correlates described above. This is the first study elucidating both the reproductive and stress related endocrine patterns and their behavioural correlates, encompassing reproductive, non-reproductive periods and pregnancy periods, in the African lesser bushbaby.

## 12:00-12:15

Towards conservation genomics of northern Madagascar mouse lemur

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Madagascar is one of the hottest biodiversity hotspots and it faces critical problems of deforestation and poaching, and, as such, it represents a conservation priority. It is increasingly recognized that ancient climatic changes have influenced temperate and tropical species alike. However, in many regions it is difficult to disentangle anthropogenic from climatic effects. Madagascar represents an exception for such a large island, as it was colonized only recently by humans (~2-4000 yBP). It is thus a very good model to study the Holocene demographic history of endemic species. Our ongoing research focuses on three lemur genera (*Propithecus*, *Lepilemur* and *Microcebus*) from northern Madagascar and uses a comparative and multidisciplinary approach combining ecological field data, remote sensing tools, genetic and genomic data to model recent and ancient forest changes and population demography. After estimating population sizes, and sampling exhaustively populations from these species, we aim at bringing together traditional genetic (microsatellites and mt-DNA) and genomic (RAD-seq) data within a single framework. We will present preliminary results on the recent natural history of mouse lemur (*Microcebus tavaratra*) populations and insights on the relative effects of human and environmental (past climatic) factors. While answering these questions is very challenging, the incorporation of genomic data provides accuracy not reachable just a few years ago.

## 12:15-12:30

Summit metabolism and metabolic expansibility in Wahlberg's epauletted fruit bats: Seasonal acclimatisation and effects of captivity

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Summit metabolism ( $M_{\text{sum}}$ ), the maximum rate of resting metabolic thermogenesis, has been found to be broadly correlated with climatic variables and the use of heterothermy in some endotherms. Far less is known about  $M_{\text{sum}}$  and metabolic expansibility [ME, the ratio of  $M_{\text{sum}}$  to basal metabolic rate (BMR)] in bats compared to many other endotherm taxa. We measured BMR and  $M_{\text{sum}}$  during winter and summer in captive and wild populations of a pteropodid from the southern subtropics, Wahlberg's epauletted fruit bat (*Epomophorus wahlbergi*) in Pretoria, South Africa. The  $M_{\text{sum}}$  of fruit bats ranged from  $5.178 \pm 0.611$  W (captive, summer) to  $6.006 \pm 0.890$  W (captive, winter), and did not vary significantly between seasons. In contrast, BMR decreased by 17-25% in winter. The combination of seasonally stable  $M_{\text{sum}}$  but flexible BMR resulted in ME being significantly higher in winter than summer, ranging from  $7.24 \pm 1.49$  (wild, summer) to  $13.11 \pm 2.14$  (captive, winter). The latter value is well above the typical mammalian range. Moreover, both  $M_{\text{sum}}$  and ME were significantly higher in captive bats compared to wild individuals; we speculate this represents a phenotypic response to a reduction in exercise-associated heat production while in captivity. Our data for *E. wahlbergi*, combined with those currently available for other chiropterans, reveal that  $M_{\text{sum}}$  in bats is highly variable compared to allometrically expected values for other mammals.

### **Session: Mole and root rats – research from the underground and labs**

**14:30-14:45**

Ansell's mole-rats (*Fukomys anselli*, Bathyergidae): From laboratory to the field - how representative are the laboratory studies?

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Ansell's mole-rats, subterranean rodents endemic to Zambia, have been kept, bred and intensively studied in captivity since 1986. They have become model species for laboratory studies of sensory biology, particularly hearing, vision and magnetoreception. The social and mating systems of captive groups are characterized by monogamy with helpers, multigenerational family and eusociality.

The maintenance of the family is based on individual recognition and incest avoidance, which is strong between father and daughters, sisters and brothers, but looser between mother and sons. Reproduction and life histories estimated in the laboratory include very slow development, small litters, non-seasonal reproduction, intensive sexual activity of the breeding pair, long lifespan, and higher life expectancy in breeders than non-breeders. Females are induced ovulators and we suggested provoked dispersal. The animals are arrhythmic; metabolism is low during the first years of captivity, mechanisms of thermoregulation were described. In spite of all this progress, the comparative data and confirmation from the field have been missing for a long time. Recent field studies (telemetry, uncovering complete burrow systems, and estimation of genetic relationships) confirmed monogamy and eusociality with family sizes comparable to those of *F. damarensis*. Furthermore, xenophobia was relativized, suggesting the existence of the "dear enemy effect", and an effect of ambient temperature upon rhythmicity was revealed. Here, we compare the achievements, pros and cons, and caveats of the field and laboratory research, suggest and analyze the concordance as well as difference between results of both approaches. We identify missing knowledge and suggest promising research topics and approaches in the field and in the laboratory.

#### 14:45-15:00

How African mole-rats survive belowground? Infrared thermography approach

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Subterranean rodents are well adapted for life in underground burrow systems protecting them from predation and rapid temperature changes. There are various adaptations how they cope with different stresses of the belowground environment. Dissipating of metabolic heat belongs to the most serious problems, because high humidity and absence of air currents in sealed burrows constrain convection and evaporation from the body surface. Using infrared thermography, we measured body surface temperatures in two species of African mole-rats (Bathyergidae) in a gradient of ambient temperatures and also immediately after digging in different soils. We identified body areas responsible for heat dissipation involved especially after energetically costly activities. Contrary to our expectations, we observed remarkable decrease of mole-rats' surface temperature after the end of the digging trials, especially in soft and moist soil. Our results suggest that mole-rats (and probably other subterranean mammals as well) may effectively avoid overheating in burrows by effective cooling while digging, especially in wet soil after rains.

## 15:00-15:15

Determining adrenocortical activity as a measure of stress in the Damaraland (*Fukomys damarensis*) and Natal mole-rat (*Cryptomys hottentotus natalensis*)

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African mole-rats exhibit a broad spectrum of social organisation which culminating in social species with a distinct reproductive division of labour. The social species are especially interesting study models to unravel the physiological mechanisms of social suppression that are operational within a mole-rat colony. However, as an initial step, a reliable species-specific method should be available for determining potential stress-related endocrine

responses in suppressed individuals. In this regard, the assessment of adrenocortical function using faeces as a hormone matrix is a wildly accepted method nowadays, since faeces maybe collected easily, and sampling is feedback-free. We therefore examined the suitability of five enzyme immunoassays (EIAs) for monitoring adrenocortical function in Damaraland and Natal mole-rats based on faecal glucocorticoid metabolite (fGCM) analysis by performing an ACTH challenge on 12 individuals of each species at the University of Pretoria, South Africa. Intramuscular injections of synthetic ACTH (50-100 IU/kg) yielded overall fGCM levels of 16 – 220% (*C. h. natalensis*) and 58 – 224% (*F. damarensis*) above pre-injection levels depending on the various EIAs tested, revealing the suitability of a group-specific EIA detecting 11,17-dioxoandrostanes for determining glucocorticoid output for both species. Preliminary results reveal no sex-related differences in fGCM concentrations for *F. damarensis* or *C. h. natalensis*. In addition, no differences in fGCM levels were found when comparing respective hormone concentrations from wild-caught and captive Damaraland mole-rats, although highest values and an overall distinctively higher variation occurred in the wild Damaraland males. With a reliable method for assessing adrenocortical endocrine function now available for at least some mole-rat species, the potential link of stress and social suppression can be further investigated.

### 15:15-15:30

New insights into postnatal development-, growth pattern- and behavior in a eusocial rodent, the naked mole-rat (*Heterocephalus glaber*)

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The naked mole-rat is characterised by a complex social system, with a division of labor. Reproduction is monopolised by a breeding pair. The breeding female, the “queen” has to defend and maintain her position in the colony every day. Hierarchical struggles within the colony have a negative effect on the reproduction such as termination of pregnancy or high offspring mortality. Attempts to continuous breed and successful rear of naked mole-rat pups, have

often failed in captivity. Consequently, data on reproduction and pup development in particular, are very limited and incomplete. To date, there is no long-term study in postnatal pup development that work with a high offspring sample size or gender-specific pup development in these rodents. The present work is a detailed report of postnatal behavior, growth pattern and development in naked mole-rat pups for the first 80 days postpartum. These data are based on 13 established colonies, which produced altogether 63 litters (680 newborns) over a study period of six years. In our study neonates were born with a birth weight of 1.0-2.7 g, but they only survived by a birth weight at least of 1.4 g. Pups in large litters showed a significant lower birth weight than compared to pups in smaller litters. Birth sex ratio was male biased regardless of age of the queen or sex ratio of the colony. Infant mortality was quite high in the first days and, as we can show, increases with colony size. After three weeks, newborns opened their eyes, explored the tunnel system, participated on colony work and ate solid food. Five weeks postpartum, pups started attempts to establish their position amongst other siblings within the litter and the colony. The results of our study give additional new insights and simultaneously a more comprehensive and detailed overview of postnatal development in this species.

## 16:00-16:15

New insights into the magnetic sense of African mole-rats

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Mole-rats of the genus *Fukomys* are the only terrestrial mammals for which a magnetic compass sense has been undisputedly proven. When these animals are placed in a circular arena they build a nest, the direction of which is chosen with respect to the magnetic field lines. This simple assay has been used to prove the existence of a magnetic sense in various mole-rat species and has yielded significant insights into the properties of the underlying magnetoreceptors. Here, we present first nest building data of *F. micklemi*, revealing astonishing differences to the results from other closely related species. In contrast to all other tested mole-rat

species, *F. micklemi* shows a N-S axial preference, meaning that the nests are either built in the northern or southern sectors of the arena. All other mole-rat species so far had clear angular preferences for a single sector. An axial preference was thought to be a unique characteristic of epigeic small mammals such as mice and voles for which it was explained by their mechanism of magnetoreception that is believed to be fundamentally different from the mechanism in mole-rats. Our new findings require a different explanation and are therefore compared to our recent results on the magnetic sense of wood mice and discussed within the framework of what is known about mammalian magnetoreception so far.

### 16:15-16:30

How to trigger mating behaviour of Zambian *Fukomys anselli* mole-rats?

Sabine Begall, Christiane Vole, Angelica Garcia-Montero, E. Pascal Malkemper and Hynek Burda

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Mole-rats of the genus *Fukomys* are subterranean rodents that live in eusocial families. Only the founder pair reproduces, whereas their offspring (non-breeders) remains reproductively quiescent while staying within their home family. Incest avoidance between parents and offspring and between brothers and sisters is based on individual recognition, most likely via olfactory signals. If two unfamiliar mature non-breeders of opposite sex meet, in many cases mating takes place soon after their first encounter. In a previous study, we investigated the mating behaviour of Ansell's mole-rats (*Fukomys anselli*) from Zambia by using adult mole-rats that were non-reproductive at the time of first testing. Pairs that showed courtship behaviour were tested repeatedly (maximally three times a week over a period of 10 weeks); between the trials the animals were put back to their respective family. The animals copulated frequently within one session and had an increased interest in sexual behaviors (e.g., anogenital grooming, cunnilingus and fellatio) during the whole study period. Recently, we compared the copulation frequency of breeding pairs of established families under

different experimental conditions. Factors implying a new surrounding (e.g. change of substrate or terrarium), but also certain magnetic conditions could trigger a higher occurrence of copulations. We speculate, that the reproductive pair strengthens its pair bond after encountering new environmental conditions in the laboratory. Although the subterranean ecotope is buffered against many fluctuating abiotic factors (e.g. temperature, humidity, radiation) for most time of the year, seasonal events (e.g. heavy rains) could lead sporadically to entirely new conditions (e.g. abandonment of the burrow system due to flooding). Alternatively or in addition, the pair might soothe stressful situations by release of oxytocin during orgasm. Our results are of considerable importance for fertility studies in wild animals and could prove valuable for successful keeping and breeding of mole-rat colonies in the lab.

**16:30-16:45**

Unusual thyroid hormone ratio in Ansell's mole-rats - a novel mechanism to cope with hypoxic environment?

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Ansell's mole-rats (*Fukomys anselli*) are subterranean, long-lived rodents endemic to Zambia. They belong to the family Bathyergidae, which comprises at least 22 species that are only found in sub-Saharan Africa and have evolved unique morphological and physiological adaptations to the subterranean niche. For instance, the metabolic rate of Ansell's mole-rats is significantly lower than expected based on allometry, and they show a high tolerance of

hypoxic and hypercapnic conditions characteristic for burrow systems. Low metabolic rate and hypoxia tolerance are usually strongly associated with peculiarities of thyroxine and triiodothyronine levels, the two major thyroid hormones. Thus, we investigated the thyroid hormone system of *F. anselli* on genetical and hormonal level to understand proximate mechanisms of these physiological adaptations. The genetical analyses showed that Ansell's mole-rats have a conserved thyroid hormone system comparable to other mammalian species. At the same time, free thyroxine levels of *F. anselli* were about ten times lower than those of guinea pigs and rats, whereas the free triiodothyronine levels, the main biologically active form, did not differ significantly amongst species. The resulting thyroid hormone ratio is unusual for a mammal and mimics a state of natural hypothyroxinemia, a condition usually associated with developmental impairments. However, development of *F. anselli* is normal though rather slow. Total thyroxine levels were also significantly lower than in control species, suggesting that distinct mechanisms exist in *F. anselli* that downregulate thyroxine levels as an adaptation on the one hand, and counteract developmental impairments on the other hand. We explain our results in the light of a non-genomic pathway initiated by thyroid hormones, as a novel mechanism to cope with the hypoxic subterranean habitat. These new insights contribute to a deeper understanding of the exceptional adaptations shown by bathyergids.

## 16:45-17:00

Exploratory behaviour, learning and memory in wild and laboratory Damaraland mole-rats

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Damaraland mole-rats are eusocial subterranean rodents that exhibit a caste system. Colonies of Damaraland mole-rats comprise dominant breeding individuals and subordinate non-breeding individuals. Subordinate non-breeding individuals in each colony exhibits a work related division of labour (infrequent workers and frequent workers). Frequent workers perform the majority of the work in the colonies, while the infrequent workers and breeding animals do relatively little. Hence, exploratory behaviour, learning and

memory were investigated in Damaraland mole-rats to explore possible caste differences in their performance. Damaraland mole-rats are popular study subjects for both laboratory and field studies therefore the performance of wild trapped animals was also compared with that of laboratory animals on the premises that the less complex, more predictable habitat of laboratory animals may lead to impairment of learning behaviours. Learning and memory was tested in a Y-maze over four days with 10 trials per day, where time to complete the maze and number of mistakes was recorded. No meaningful differences were found in exploratory behaviour between either the different castes or wild and laboratory groups. Time to complete the maze reduced significantly from the 1<sup>st</sup> to 2<sup>nd</sup> day for all groups, as did the number of mistakes made by laboratory animals. Wild animals made significantly less mistakes on the first day compared to lab animals. Although initial performance of wild animals seemed to be better than that of lab animals, no differences between lab and wild animals were observed from the second day onwards. Therefore, it is thought that group housing in laboratory Damaraland mole-rats provides sufficient stimulation and enrichment to counter potential negative behaviours and laboratory housing does not appear to affect the mole-rats adversely.

**17:00-17:15**

Activity pattern and ecosystem function of the giant mole rat (*Tachyoryctes macrocephalus*)

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The giant mole rat (*Tachyoryctes macrocephalus*) is a rodent endemic to the Afroalpine zone of Bale Mountains in Ethiopia. Its subterranean lifestyle is not as strict as in other species of the genus, among which it is the largest, reaching body mass of around 1 kg. It forages above ground, usually in the immediate vicinity of burrow openings. Locally it can reach extremely high population densities, which makes it a key factor altering the ecosystem. Besides this, it is an important prey species of the endangered Ethiopian wolf. The aim of our study was to reveal activity patterns

of free-living mole rats in wet and dry season and to evaluate environmental impact of their activity. We radio-tracked 20 mole rats for 18 days in the wet and dry seasons. The mole rats spent 80% of the time in a nest and their activity was mostly confined to daylight hours, with less than 1 hour of aboveground activity per day. Home ranges calculated as the minimum convex polygons were very small (105 and 75 m<sup>2</sup> in the wet and dry season, respectively), but 6 out of the 20 individuals moved between the seasons up to 300 m far. Mole rat territories were characterized by dramatically reduced plant cover and significantly softer soil than randomly selected points across the study area. Abandoned mole rat burrows were also massively utilized by other rodent species, which further underlines the profound impact of the giant mole rat on the ecosystem. The study was supported by GACR (P506/11/1512) and GAJU (156/2013/P).

### 17:15-17:30

Reproduction in the East African root rat, *Tachyoryctes splendens* (Rodentia: Spalacidae), from Tanzania: The importance of rainfall

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The reproductive biology of the East African root rat (*Tachyoryctes splendens*), a solitary subterranean rodent, is currently fragmentary. Over an entire calendar year, we assessed the body mass, reproductive tract morphometrics, gonadal histology and measured gonadal steroids from 120 males and 120 females collected in Tanzania. The objective of the study was to assess if the reproductive biology of the root rat reflected the bimodal pattern of rainfall characteristic of East Africa. Peaks in mean gonadal mass, increases in concentrations of reproductive hormones and the presence of corpora lutea, and testes mass, seminiferous tubule diameter and testosterone titre mirrored the annual peaks of

precipitation at the study area. Two distinct peaks of breeding activity were apparent and 16.20% ( $n = 19$ ) and 32.97% ( $n = 40$ ) females were pregnant and lactating, respectively. Together with field observations of the temporal occurrence of pregnancies, infants, juveniles and sub-adults, the data shows that *T. spenderi* cues its breeding with the patterns of rainfall, such that offspring are born in the latter half of each rainy season, from April to July and November to December.

## Abstracts for poster presentations

Poster abstracts are presented in alphabetical order based on the presenter's family name. Further, each poster is associated with a number ("P") and installed in order following this number system.

### P1

Small mammals in a suite of indicators to determine the instream water requirements for South African dryland rivers

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Nearly half of South Africa's rivers have temporary stream flow – a function of the semi-arid/arid climate prevailing over much of the region. Temporary rivers are distinguished by their highly variable and unpredictable hydrological regimes, large disturbances (extreme floods and droughts) and the loss of surface water connectivity that confines surface water to isolated pools. Methods developed for assessing the instream water requirements (IWR) in perennial rivers are poorly equipped to deal with these factors and were adapted for use in South Africa's dryland rivers. DRIFT-Arid, a newly developed holistic IWR-method uses several driving (e.g. the onset of stream flow after the dry season) and responding indicators (e.g. the number of pool-dwelling fish species) to predict ecological and socio-economic impacts to hydrological changes. The aquatic communities most often included in the suite of responding indicators, both for perennial and temporary rivers, are aquatic macroinvertebrates (MI), fish and riparian vegetation (RV). There are, however, a number of factors limiting the use of MI and fish communities as indicators in the temporary rivers of central South Africa. For example, fish communities, when present, are relatively species-poor (between 5 and 16 species) and are dominated by hardy, generalist species. The inclusion of terrestrial vertebrate species have been largely neglected up to now, even though their life histories are known to be significantly affected by hydrological changes. They have been

included collectively under “terrestrial wildlife” in a few studies, but predictions of change for this group was mainly based on expert opinion and not on field-based research. This contribution correlates the presence and species composition of small mammals in the diet of the African clawless otter *Aonyx capensis* with stream flow and selected environmental variables, and investigates if a connection can be made between prey selection and the persistence of ephemeral pools.

## P2

### Phylogenetics of some southern African horseshoe bat species

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Knowledge about phylogenetic relationships provides important information for most biological questions. Whether studies deal with e.g. diversity, biogeography, comparative approaches, and ecological theories or in testing long-standing hypotheses about adaptation, they all require consideration of systematic relationships and shared evolutionary history. Phylogeny can be used to study both patterns and processes of evolution. Its importance lies in providing a phylogenetic framework to any feature or trait of a taxon studied. The most fruitful analyses will be those based on the strongest phylogenetic inferences. Bats are the second most specious group of mammals and display enormous diversity but relative to studies on other continents, there has been little research on African bats. However, this has been changing and as more and more research is done on African bats, on a variety of different topics, the need for robust phylogenies has increased. We are interested in one of the most unique phenotypic trait of bats, echolocation. We found considerable variation of echolocation frequencies within some horseshoe bat species and are

investigating the reasons for this signal divergence. Here, we present phylogenetic reconstructions of seven African horseshoe bat species of the genus *Rhinolophus* based on an extensive database, which also includes museum samples. Our aim was to re-assess and complement the systematics of these species and to reveal hidden lineage diversification as an aid to explaining phenotypic divergence. The systematic results will provide information for the diverse areas of research requiring a phylogenetic framework.

### P3

#### Bat fauna of Lesotho

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Based on literature records, revision of museum material and on evidence from a new field survey, 70 records of nine bat species, belonging to five families, are available from the Kingdom of Lesotho. *Rhinolophus augur*, *Nyctinomus aegyptiacus*, *Cistugo lesueuri*, and *Neoromicia capensis* are the most common species of the Kingdom (10–16 records per species). They are also widespread, having been found in all altitudinal zones. *Myotis tricolor* and *Eptesicus hottentotus* are medium frequent bats in Lesotho (7 and 8 records, respectively). While *M. tricolor* is known mainly from more elevated sites, *E. hottentotus* was found in rather lowland regions. *Laephotis wintoni* was repeatedly documented only in the Sehlabathebe NP in the highest altitudes of the Kingdom above 2400 m a. s. l. *Miniopterus natalensis* is considered a rare bat in Lesotho, being known from three sites in lower elevations only. The old literature record of *Myotis bocagei* needs to be revised.

## Hunting, host longevity, and pathogen persistence in a Madagascar fruit bat community

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In light of the ongoing West African Ebola epidemic, the role of bats as reservoirs for highly virulent zoonotic pathogens is receiving increasing attention. An ecological understanding of the mechanisms enabling pathogen persistence and motivating epidemic spikes in transmission will be essential to any public health effort to predict and prevent future incidence of bat-borne pathogen spillover. Previous theoretical and experimental work demonstrates that anthropogenic culling of natural pathogen reservoirs can counter-intuitively elevate pathogen prevalence (and corresponding zoonotic risk) by relaxing natural density-dependent controls, opening niche space for migration of susceptible young, or enabling establishment of less virulent pathogen strains. We are exploring the impacts of human hunting on host longevity and implications for pathogen persistence among fruit bats consumed as bushmeat in the Madagascar ecosystem. In particular, hunter interviews, combined with cementum annuli age analysis of extracted tooth samples of *Pteropus rufus* and *Eidolon dupreanum* fruit bats indicates significantly greater hunting pressure—and correspondingly shorter average lifespans—for *P. rufus* versus *E. dupreanum*. We explore these age data and model corresponding scenarios for pathogen persistence in the Madagascar fruit bat community. We are currently testing these models via collection of cross-species prevalence data for a suite of viral, bacterial, and protozoal pathogens in our system.

Sleeping single in a double bed - Energetics of social hibernation in the Malagasy dwarf-lemurs

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Mammals generally profit from social thermoregulation, and the primary benefit of sociality during hibernation is thought to be the reduction of metabolic demands during periodic arousals. It has even been postulated that the energetic advantages during hibernation might have been the driver for the evolution of sociality in some mammal species. As the necessity to show arousals and the concurring energetic costs depend on the temperature regime in the hibernacula, we tested whether this is also a plausible scenario in tropical hibernators such as the Malagasy lemur *Cheirogaleus medius*, with comparatively high and often fluctuating temperature regimes in their hibernacula. To this end, we studied group composition and energy budgets (skin temperature patterns, metabolic rate) over three hibernation and activity seasons in a total of 53 free-ranging *C. medius*. Our results show that *C. medius* mostly occupied tree hollows solitarily during hibernation, contrary to the active season, and that the energetic savings were comparable for individuals hibernating socially in groups or solitarily (both about 74% compared to the resting metabolic rate of the active season). However, in larger groups hibernation patterns were less regular and synchronized and individual torpor-arousal cycles were more frequently interrupted by euthermic group members than in individuals hibernating solitarily or in pairs. We conclude that sociality during hibernation is not necessarily driven by energetic demands, and might even be energetically disadvantageous in tropical species (at least in larger groups). Other factors, like social coherence or ecological and behavioural constraints, may be of greater influence for the evolution of sociality under tropical conditions.

A taxonomic update of the rodent biodiversity of the Republic Guinea and its importance for conservation

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In West Africa, the Republic of Guinea is situated at the edge of the Guinea-Congolese western forest block and has attracted the attention of few mammalogists. Except in the Mount Nimba region and in the "Haut Niger National Parc" very few published surveys offer an up-to-date view of the country's rodent diversity. Because Guinea is located in a transitional vegetation zone and has a diversified topography, with the Fouta Djalon High Plateau and the low wet coastal area, the country offers a wide range of habitats with a high diversity of small mammals. For this reason, many new species have been recently described from this country or discovered for the first time. The transition between forest and savannah is very extended in Guinea, consequently this region is of extreme importance for monitoring and relating the effects of deforestation to both global climate change and anthropisation. In the context of the preparation of an "Atlas of Guinean rodents," which will include a determination key and distribution maps, this review aims to update the faunal list of Guinea rodents. We will use the recent taxonomic and conservation literature data, revise collections and integrate the results from recent rapid biodiversity assessments and baseline studies. We will use the latest molecular and cytogenetic results combined with morphometric data to characterize the species and discuss implications for mammal conservation in Guinea.

The power of poo – Non-invasive endocrine monitoring of reproduction and stress

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Behavioural endocrinology is the study of the endocrine system in relation to behaviour. The involved hormones are chemical messengers secreted by specific glands, travelling through the blood system to target sites where they unfold their effect, i.e. regulating the physiology and behaviour of an individual. Therefore, hormone analysis is an ideal tool for monitoring reproductive function and responses to stressors in predominately mammals and birds, but also in reptiles, amphibians, fish, and even invertebrates. Although hormones can be measured in various biological matrices, the use of faeces as hormone matrix have gained popularity over the past 30 years as a more practical non-invasive approach for assessing gonadal and, more recently, adrenocortical activity in especially intractable free-roaming animals. However, respective assays need to be carefully validated in terms of their applicability for the species-specific hormone matrix of interest to ensure a reliable quantification of respective hormones. With a reliable test system in place, key management issues can be addressed in captive populations: like the avoidance of stress (and of situations/procedures likely to cause it), as well as optimizing breeding efforts either naturally or by assisted/artificial means. On the other hand, a reliable non-invasive approach allows field researchers to link the endocrine status of individuals or populations to certain life-history traits without interfering with the natural behaviour of the animals due to capture and restraint for invasive sampling. Using vivid examples for monitoring male and female reproductive activity and the level of stress experienced by animals, this presentation will highlight the value and inter-disciplinary approach of behavioural endocrine research.

Biodiversity, phylogeny and biogeography of Malagasy vespers  
(Chiroptera, Vespertilionidae)

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According to different authorities, Madagascar holds between six and 11 species of small vespers, including up to four genera (*Eptesicus*, *Hypsugo*, *Neoromicia* and *Pipistrellus*). Some taxa occurring on the island are thought to be shared with the African continent (between 17 and 64% depending on the authority), suggesting that some of these species are able to disperse across the Mozambique Channel, a water barrier of at least 400 km. Since morphological identification of vesper bats is highly problematic, we conducted a molecular taxonomy study, based on both mitochondrial and nuclear markers, to discriminate potential cryptic species of Malagasy and African vespers. Our phylogenetic analyses confirm that more than half of the vesper bats collected on Madagascar were misidentified in the field, and that the island holds six species, five of which are endemic. Our data also suggest that Malagasy vespers belong to two distinct clades, probably best defined as *Pipistrellus* and *Neoromicia*. Biogeographic inferences indicate that five

dispersal events occurred between Africa and Madagascar during the Plio-Pleistocene epoch.

## P9

Small mammal diversity and biogeography in the protected Albertine Rift, DR Congo sites

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The Albertine Rift has been identified as a "biodiversity hotspot", an "ecoregion" and an "endemic bird area". As such, it is recognized as an area of global importance for conservation because it contains many endemic and threatened species. Habitats in this region are composed of Afromontane forest, but some are lowland forests that have been only sampled recently for the small mammal fauna, while others have not been sampled. Redressing this lack of knowledge is of importance: (1) many species of small mammals occur in this type of habitat; (2) this region houses one of the highest human population densities. In this study, we inventoried rodents and insectivores in four sites. The highest numbers of species were found in Kahuzi-Biega National Park (55 species) and Itombwe Massif (36 species), while the lowest were found in Mt. Tshiabirimu (19 species) and Kabobo-Misotshi (17 species). It is likely that the species numbers are an underestimate, as several collected specimens may represent new species to science. Tolerant species such as *Praomys jacksoni*, *Lophuromys flavopunctatus* and *Oenomys hypoxanthus* were recorded irrespectively of the level of disturbance. However, species such as *L. rahmi*, *Myosorex* spp., *Sylvisorex* spp. and *P. degraaffi*, known to be less tolerant to disturbance, were recorded only in intact habitats. The lower species numbers for Mt. Tshiabirimu and Kabobo-Misotshi can be attributed to sampling bias. These results indicate that there is a pressing need for intensive surveys to be complimented by genetic studies.

## P10

### Diversity of small carnivores in human dominated mixed landscapes of the Vhembe District in South Africa

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Small carnivores can have a variety of important ecological functions — such as pest control, seed dispersal, pollinators and potential indicators of ecosystem integrity. Furthermore, small carnivore populations can potentially increase dramatically in the absence of large carnivores due to mesocarnivore release. Human dominated landscapes are normally deprived of large carnivores, and as such may harbour healthy small carnivore populations. In this study, we therefore investigated the presence and diversity of small carnivores in two rural villages in the Vhembe District of South Africa. We used camera traps in an occupancy modeling framework to detect small carnivores. We overlaid our study sites with 30 grids (0.3 x 0.3 km ~avg. home range of majority of small carnivores) and placed one camera trap in each grid. We stratified our study sites to include three different land-use types (village, agricultural and semi-natural area). Camera trapping were conducted in the dry season (June/July 2014) for 10-12 days in each land use type. We detected 10 different small carnivore species from a collective effort of 1062 trapping days. As expected, we did not detect any large or medium sized carnivores. Two of the 10 species were non-native species, the domestic dog *Canis lupus familiaris* and domestic cat *Felis silvestris catus*. The greatest carnivore diversity was detected in the agricultural land-use types of each study site (seven species). The villages had the lowest diversity (2-5 species), with the semi-natural sites at intermediate diversity (4-6 species). The most common native small carnivore were the Cape genet, *Genetta tigrina* (1280 detections/1000 Camera trap days), followed by the slender mongoose, *Galerella sanguinea* (513 detections). Interestingly, at both study sites we detected two rare species Meller's mongoose

*Rhynchogale melleri* and Selous' mongoose *Paracynictis selousi*. Our results suggest that agricultural areas can harbour diverse small carnivore communities, which can play an import role in small mammal predation and pest control.

## P11

Using occupancy models and nest monitoring to quantify barn owl (*Tyto alba*) presence and diet in an agricultural matrix

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Predation plays an important role in structuring prey communities, population cycles and population regulation. Predation impact depends on predator densities, distribution and feeding ecology. Therefore, this ongoing study aims to increase our ecological understanding of a common avian predator (Barn owl; *Tyto alba*) predating on a potential rodent pest (*Gerbilliscus* sp.) in an agricultural matrix. This project forms part of a larger study aiming to increase knowledge regarding the role of predation in ecologically-based rodent management (EBRM). We quantified barn owl predation impact by three methods. We first estimated prey delivery rates of adult barn owls to nests using camera traps and visual observations. We also investigated feeding preferences, in terms of most commonly predated rodent species, by analyzing regurgitated owl pellets in and around nests. Finally, we used an occupancy modeling framework to estimate barn owl occupancy in the agricultural matrix and environmental factors affecting occupancy. We overlaid our study area with a 2.5 x 2.5 km grid (average home range size), and drove around 100 km (at 40km/h) per night (for five nights), covering as many grids possible to detect barn owls. Currently we have analyzed 500 regurgitated pellets. The most

frequently predated species, *Gerbilliscus* sp. (80% of pellets), correlated with the species most abundant and identified as the main pest within crops. Prey delivery rates ranged between 5-7 prey items per night. Nest monitoring concluded that 10% of breeding pairs bred four times within six months, 10% three times, 20% two times and 40% only once. Brood size varied between 1-6 chicks. For occupancy analysis barn owl sightings varied from 0 to 4 individuals per night. Results suggest that a healthy barn owl breeding population exists and that predation is mostly directed to potential rodent pests. As such, owl predation might be a useful component in EBRM.

## P12

### Mammalian biodiversity of threatened mangrove and coastal forests in Guinea

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Coastal ecosystems, including mangroves, are especially vulnerable because of their location at the land-sea margin and because of economic and social pressures. Here we present the results of an exploratory mission, which provide an initial health status of the mangrove and coastal forest in Guinea, subject to climatic and anthropogenic changes. For this, it was necessary to describe the biodiversity of this coastal ecosystem to understand the history, demography and structure of animal communities (rodents, shrews, bats). We show the results of relative abundance of different micromammal species in mangrove, forest and anthropogenic habitats, and the molecular analyzes of barcoding. Besides the presence of a new species of Guinea endemic shrew and some information on phylogeography of some species, these results show interesting contrasts between preserved and degraded mangrove areas.

## P13

From large to small: Skull shape in Malagasy dwarf hippos

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The extinct Malagasy hippos, *Hippopotamus lemerlei* and *H. madagascariensis*, are phylogenetic dwarfs of their mainland African relative *H. amphibius*. The most impressive change is their size reduction. The Malagasy hippos are reported to be 75% smaller than their mainland ancestor. In this contribution, I used 3D geometric morphometrics integrating developmental and palaeontological data in order to analyze the morphological changes in their skull during dwarfing. The basic morphological difference from mainland hippos is found in the shape of their muzzle, which resembles that of younger individuals. Thus, in that respect, dwarfing follows a change opposite of the ontogenetic trajectory of *H. amphibius*. However, this corresponds to a small part of the total variation, as both Malagasy hippos are to a considerable degree scaled-down versions of their mainland relative. That is in sharp contrast with the major cranial modifications seen in even smaller phylogenetic dwarfs. This research has been co-financed by EU-ESF and Greek national funds through the Op. Program "Education and Lifelong Learning" of NSRF: Res. Funding Program: THALIS–UOA: Island biodiversity and cultural evolution (MIS 375910, KA:70/3/11669).

## P14

New karyotypic information for non-volant small mammals from Botswana

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Southern Africa is characterized by a wide range of ecoregions, including the Kalahari arid region of Botswana and Namibia. Studying small mammals in this unique environment provides an opportunity to understand the processes that contribute to species diversification in arid ecosystems. Although increasing efforts have

been made to describe the small mammal composition of the country during the past decade, Botswana is still considered data-deficient in terms of systematic and taxonomic studies. The description of the karyotypic composition of taxa has historically been recognized as an invaluable tool for species identification, however, thus far the number of mammal species chromosomally investigated in Botswana is considered negligible. Although numerous patterns of chromosomal variation have been reported for small mammals in southern Africa, most of the efforts were concentrated in South Africa. These studies have revealed multiple processes are at play in southern Africa and that data in this region are still lacking. Here, we report new karyotypic information for small mammals in Botswana including individuals from the Kalahari arid region, previously reported as an area of secondary contact between divergent genetics lineages in several taxa. Diploid and fundamental numbers were determined for individuals representing three orders including the following genera: *Elephantulus* (Macroscelidea); *Acomys*, *Aethomys*, *Cryptomys*, *Dendromus*, *Desmodillus*, *Gerbilliscus*, *Gerbillurus*, *Lemniscomys*, *Mastomys*, *Mus*, *Rhabdomys*, *Saccostomus*, and *Steatomys* (Rodentia); and *Crocidura* (Soricomorpha). Our data were compared to previously published karyotypes for specimens from other localities aiming to contribute to the knowledge of biodiversity and chromosomal variation of the taxa examined. These results fill in a critical gap in our knowledge of karyotype information for mammals in southern Africa.

## P15

A new classification scheme for southern African gerbils of the genus *Gerbilliscus* based on genetic and morphological data

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Currently, six species are recognized for southern African gerbils of the genus *Gerbilliscus* (*G. afra*, *G. brantsii*, *G. boehmi*, *G. inclusus*, *G. leucogaster*, and *G. validus*). Historically, greater diversity was recognized for this group (e.g. 23 synonyms for *G. leucogaster*). Furthermore, recent studies of West African *Gerbilliscus* have illuminated unrecognized diversity in this group, indicating the need for careful examination for other members of this genus using both morphological and genetic data. Here, we estimate phylogenies using DNA sequence data from both nuclear and mitochondrial markers, including sequences from three type specimens. Additionally, we examine patterns of morphological variation between and among species groups using multivariate plots for 23 cranial measurements. Phylogenetic trees estimated using Bayesian inference and Maximum-likelihood provide support for ten genetic lineages with three major clades: *G. afra* group, *G. leucogaster* group, and *G. boehmi*. Sequences from museum type specimens reveal the phylogenetic position of three of the oldest types in the genus: *G. boehmi* (Noack, 1887), *G. leucogaster* (Peters, 1852), and *G. schinzi* (Noack, 1889). Morphometric results appear consistent with genetic data, indicating that the observed genetic species also exhibit distinct morphological features. We therefore propose a new classification scheme for southern African *Gerbilliscus* including new insights into their geographic distributions.

## P16

Birth and postnatal care in a eusocial rodent, the naked mole-rat (*Heterocephalus glaber*)

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The naked mole-rat (*Heterocephalus glaber*) is a eusocial rodent, in which survival of the progeny and the whole group depends on the colonies social interactions. Therefore, it is important to survey how the colony as a whole takes care of the pups. Cooperative brood care as such is a great selective advantage and further questions like how and which colony member assists the breeding female

before, during and after birth. Here we challenge the common assumption that the colony and the breeding male in particular, do not assist the breeding female during parturition. Along with this question, we documented in detail the parturition e.g. duration, time of birth, place of birth and birth interval in naked mole-rats. Once the birth contractions have started the breeding female becomes restless, running through the system, autogrooming intensively and frequently licks her urogenital region. During birth, the breeding female is assisted by other colony members, and, as we found, particular by the breeding male. In our studies, the breeding male provided the major support during parturition. He licks amniotic fluid before birth, cleans the pups and their nostrils from the embryo membrane, consumes the placenta, carries neonates, rebuilds the nest, nuzzles and cleans the vagina of the breeding female. This newly described role of the colony and the breeding male during the birth process, especially the primary attention to the neonates in the first minutes after birth may explain the high pup mortality seen in other captive naked mole-rat colonies when the helpers are absent at birth. Thus, support provided by the colony seems to be an important factor for offspring survival in the naked mole-rat.

## P17

Population dynamics and breeding patterns in System Rice Intensification (SRI) in irrigated rice ecosystems in Tanzania

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*Mastomys natalensis* is the most important vertebrate pests in Sub-Saharan Africa. This study investigated the population dynamics and

breeding patterns of this mouse in system rice intensification (SRI) in irrigated rice cropping systems in eastern Tanzania. The *Mastomys natalensis*, population varied months but not with either SRI or traditional cropping system. The highest population peak was observed during the dry season from August to October and this species is sexually active throughout the year in the study area, although it reaches the highest level when rice is at the maturity stage. This suggests that breeding is highly influenced by the presence of a rice crop. More juvenile individuals were recorded in one to two months after the highest breeding peak and the sex ratio of *M. natalensis* was not skewed to either males or females, indicating that it was at parity. Regular control and sustainable operations such as the use trap barrier system are thus essential if rodent pest populations are to be kept within tolerable limits.

## P18

Haematological and genotoxic responses in an urban adapter, the Banana Bat, foraging at wastewater treatment works

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Wastewater Treatment Works (WWTWs) are a ubiquitous feature of the urban landscape. The Banana Bat, *Neoromicia nana* specifically exploits the high abundance of chironomid midge prey at WWTWs but these populations also have higher levels of non-essential metals (Cd, Cr, Ni) in their tissues than bats foraging at unpolluted sites. Primary physiological responses may be elicited in pollutant-exposed animals. We investigated whether pollutant exposure at WWTWs impacts haematological and genotoxic parameters in *N. nana*. We compared four measures of haematological/genotoxic damage between *N. nana* foraging at three WWTWs and two unpolluted sites located in KwaZulu-Natal, South Africa: DNA damage (Comet assay), total antioxidant capacity (FRAP assay), chromosomal aberration (micronuclei formation) and blood oxygen capacity (haematocrits). There was significantly higher DNA damage in *N. nana* at WWTWs than in bats from unpolluted sites, suggesting inadequate repair to double stranded DNA breaks. In addition, WWTW bats had significantly lower antioxidant capacity. This

suggests that bats at WWTWs may have a diminished capacity to cope with the excess reactive oxidative species produced from pollutants such as metals. There was no increase in micronucleus frequency. Haematocrits were however, significantly higher in WWTW bats, possibly due to erythrocyte production in response to certain pollutants. Thus, effects of pollutant exposure in bats foraging at WWTWs elicit sub-lethal haematological and genotoxic responses, which may pose serious long-term risks. This provides evidence that WWTWs, that are aimed to remove pollutants from the environment, can themselves act as a contamination source and can pose a threat to animals exploiting these habitats.

## P19

### Small mammals (Rodentia & Insectivora) in Busanga Plains: A review

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Busanga Plains is an important conservation area in Zambia. It houses the Busanga Swamps a critical habitat in Kafue National Park and a RAMSAR site (1659). It is well known for its outstanding biodiversity. Since Ansell's work in 1978, few studies have been conducted to update the checklists of small mammals in Kafue National Park and Zambia as a whole. Small mammals assume important roles in ecosystem functionality, as they determine linkages within food webs by feeding on large amounts of plant material, whilst acting as hosts for predators and parasitoids. Thirty-three species belonging to nine families of Rodentia were identified as occurring in Busanga Plains, while five species are thought to occur based on their nested distribution patterns in Zambia's agro and eco-regions, specifically in high rainfall areas (Agro region III > 1000 mm/annum) and in eco-regions described as Zambezian

flooded grasslands and central Zambezian Miombo woodlands. With regards to insectivores, nine species belonging to two families were identified as occurring in Busanga Plains. Two species (*Crocidura fuscomurina* & *Potamogale velox*) were not recorded in this area, but possibly occur based on their nested distribution in eco-regions similar to Busanga Plains.

## P20

Historical, geographical and morphological changes of two cryptic species of vlei rats (*Otomys angoniensis* and *O. auratus*) in the northern escarpment, South Africa

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Reductions in body size of organisms can be a result of rising temperatures associated with anthropogenic climate change. This phenomenon is being reported in a number of species on different continents and it applies to both terrestrial and aquatic environments. Using museum and recently collected specimens we studied geographical and temporal changes in skull size of two sibling species of rodents, *Otomys auratus* and *O. angoniensis* in the northern great escarpment (former Transvaal) of South Africa. The two *Otomys* species occupy different habitats/biomes, *O. auratus* (Grassland Biome) and *O. angoniensis* (Savanna Biome). In this study we hypothesized that morphological characters of the two sibling species occupying different biomes should vary in space and time according to the predictions of Bergman's Rule. Bergman's rule posits that size decreases with increasing temperature. We used the greatest length of the skull (GLS), zygomatic width (ZYW), interorbital constriction (IOC), braincase width (BW), maxillary tooth row length (MXTRL) and nasal width (NAW) as indicators of such changes. The study found that body size of *O. auratus* in Gauteng, Limpopo, Mpumalanga and North West provinces varied both geographically and temporally, being smaller toward the equator and

decreasing with time in relation to an observed increase in temperature. Using greatest length of skull as a surrogate for body size, the study found a significant increase in GLS with increasing latitude, thus conforming to Bergmann's rule. *Otomys angoniensis* did not show any change when tested using both multivariate and univariate morphometric approaches. We attribute the changes in *O. auratus* to its sensitivity to heat which is different to *O. angoniensis*, and its habitat preference which is very fragmented in its distribution in isolated-islands. This might have led to the discontinuous distribution of this species which led to its population isolation promoting rapid genetic and associated adaptive morphological changes.

## P21

Diversité et distribution spatiale des petits-mammifères non-volants de la forêt d'Ankerana, Centre-Est de Madagascar

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En vue de la préparation d'un plan de gestion de la forêt d'Ankerana pour une zone de conservation hors site du projet minier Ambatovy, deux sessions d'inventaire des petits-mammifères ont y été réalisées. Six sites compris entre 400 et 1000 m d'altitude répartis sur deux versants, le Sud-Ouest et le Nord-Est, ont été explorés. Dans chaque site, six lignes de trous-pièges et trois de pièges actifs standard ont été installées. Pour l'ensemble de ces études, 25 espèces ont été recensées dont 15 des Afrosoricida, une des Soricomorpha, neuf des Rodentia. Au sujet de la diversité spécifique, sur le versant Sud-Ouest, la communauté des Afrosoricida et celle des Rodentia sont les plus variées et avec répartition plus homogènes entre 600 - 900 m d'altitude. Sur le versant Nord-Est, ces remarques précédentes correspondent au site du 800 - 900 m. Suivant l'exposition des versants, les comparaisons des sites de même bande d'altitude montrent qu'au niveau de 600 -

800 m, la diversité de la communauté des Afrosoricida et celle des Rodentia du Sud-Ouest sont les plus importantes ; de même concernant les Afrosoricida des sites de 800 – 900 m. Par contre, chez les Rodentia de ces derniers sites, la communauté du Nord-Est est la plus intéressante. La variation de la diversité en fonction de l'altitude démontre la présence des micro-habitats spécifiques pour certaines espèces, impliquant ainsi la nécessité de l'importance de la préservation du site entier.

## P22

Mise en place d'un système de lutte intégrée contre deux espèces exotiques envahissantes *Rattus norvegicus* et *Rattus rattus* au site minier d'Ambatovy, Madagascar

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Ambatovy est un grand projet minier d'exploitation de nickel et de cobalt situé dans l'Est de Madagascar.

La zone de bail est subdivisée en deux parties : la zone de conservation où cohabitent les espèces autochtones et exotiques comme *Rattus rattus*, *Mus musculus* et *Suncus murinus* ; et l'empreinte minière avec les hameaux avoisinants où l'on rencontre aussi ces espèces et *R. norvegicus*. Afin d'assurer la préservation de la biodiversité dans la région d'Ambatovy ainsi que pour assurer la santé de la population locale, le projet Ambatovy est en train de mettre en place un système de lutte intégrée contre l'intrusion des deux espèces de rongeurs invasives *R. rattus* et *R. norvegicus* dans la zone de conservation. Une recherche sur la dynamique de population de ces rongeurs ainsi que leur répartition spatiale a été effectuée. De novembre 2013 jusqu'en Octobre 2014, à raison d'une session de capture tous les 45 jours, un quadrillage par lignes de pièges a été installé au niveau de trois stations d'étude : centre de forêt, lisière forestière et fragment de forêt. En outre, des pièges sont aussi installés au niveau des hameaux. Au total 346 individus

de *R. rattus* et 11 de *R. norvegicus* ont été capturés. Ces deux espèces ont été trouvées au niveau des hameaux et seulement *R. rattus* a été observée dans les trois stations situées au niveau des formations forestières. Une variation saisonnière de la densité de ce groupe faunique a été notée. Les fragments de forêts hébergent la plus forte densité de *R. rattus*, suivis par la lisière forestière et le centre de forêt. Aucune trace de *R. norvegicus* n'a été notée dans la forêt naturelle. Nous discutons la réalisation de la lutte intégrée proprement dite basée sur les résultats de ces recherches en considérant les variations saisonnières et la répartition spatiale.

## P23

Importance des inventaires intensifs sur l'évaluation de la richesse spécifique en petits-mammifères non-volants : cas de la zone de conservation d'Ambatovy-Analamay, Madagascar

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Dans le but d'évaluer l'état et la diversité de la population des petits-mammifères non-volants dans la zone de conservation du site minier d'Ambatovy-Analamay, des inventaires et suivis ont été entrepris. Les travaux sur terrain ont été réalisés entre juillet 2008 et avril 2013 avec 12 missions. Deux méthodes de piégeage ont été adoptées, les lignes de trous-pièges et les pièges actifs standard. Les résultats des observations directes sont aussi considérés. Au total, 5621 nuits-trous-pièges et 10 490 nuits-pièges ont été effectuées. Suivant la mission, le nombre d'espèce recensée varie de cinq à 17. En cumulant les résultats obtenus, la richesse spécifique de la zone de conservation passe des 10 à 25 dont 15 Afrosoricida, un Soricomorpha et neuf Rodentia. En comparant ces résultats avec ceux des évaluations rapides effectuées en 1997 et 2004, huit espèces ont été nouvellement recensées. Au cours des successions

d'inventaire, il y a parfois apparition d'espèce nouvellement recensée. Des inventaires intensifs dans une zone d'étude pourraient aider la découverte des particularités en termes de richesse spécifique dans une zone d'étude.

## P24

### Filarial and haemosporidian parasites in Malagasy bats

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We investigated filarial and haemosporidian parasites circulating in bats to understand their diversity and explore the importance of biotic and abiotic factors shaping the distribution of these parasites. In total, 947 specimens representing six of the eight known bat families on the island and 31 of the 44 described taxa were sampled from 52 sites (disproportionate to western dry forests). Samples were screened for the presence of parasites through both molecular and morphological approaches. Three main groups of nematodes were recognized, the most prevalent group is represented by *Litomosa* spp. infecting members of the family Miniopteridae; a second cluster including the genus *Litomosoides* infecting *Pipistrellus* cf. *hesperidus*, which is described for the first time in Malagasy members of the subfamily Vespertilioninae; and a third cluster is composed of undescribed filarial nematodes found in *Miniopterus griveaudi*, *Myotis goudotii*, *Neoromicia matroka*, and *Otomops madagascariensis*. *Litomosa* clades do not demonstrate

host specificity, nevertheless, Mantel test showed a clear separation of taxa based on geographic distance. Regarding the haemosporidian parasites, two main groups were distinguished based on molecular and morphological analysis, with *Polychromophilus melanipherus* circulating in the eight *Miniopterus* spp. sampled and *P. murinus* detected in *Myotis goudotii*. *Polychromophilus melanipherus* was the most prevalent with 18 out of the 20 sites sampled being positive. Future work on the blood parasites of bats should determine infection patterns in taxa not included in these analyses, specifically from the eastern portion of the island and address different points related to the biological cycle of these vector-borne infections.

## P25

### Hemoparasites in Madagascar fruit bats

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Bats have received attention in recent years for their role as the natural reservoir for several emerging human diseases—including Hendra and Nipah henipaviruses, Ebola and Marburg filoviruses, and SARS-coronaviruses. Increasing evidence suggests that bats support unique immune systems enabling them to host otherwise virulent infections without demonstrating ostensible disease. Though bats have been acknowledged reservoirs for several families of intraerythrocytic protozoans (parasites which infect host red-blood cells, including species of the same *Plasmodium* genus as human malaria) for over a century, in Madagascar, no published work confirms hemoparasite infection in any of three endemic fruit bats. Microscopy on blood smears collected by our team in 2013-2014 is suggestive of blood parasite infection in at least two species of Malagasy fruit bat (*Pteropus rufus* and *Eidolon dupreanum*). PCR-assay of dry blood collected from these bats indicates no positivity to

primers in the Haemosporida family, making us hypothesize the presence of a different Apicomplexa protozoan, likely hepatozoan or Babesia, in our samples. Life stage specific patterns in pathogen prevalence in both bat species mimic those observed for malaria pathogens in other mammals (including humans), with elevated prevalence in susceptible young. Higher prevalence in tree-roosting *P. rufus* versus cave-roosting *E. dupreanum* is suggestive of a mosquito vector mode of transmission, a hypothesis we are currently investigating further.

## P26

Habitats préférentiels de *Microgale* spp. de Manjakatombo-Ambatolampy et nouvelle information sur la distribution de *M. gymnorhyncha*

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L'étude effectuée en pleine saison hivernale au niveau du massif forestier d'Ankaratra, commune rurale de Manjakatombo, district d'Ambatolampy lors de la mise à jour des données d'inventaire sur Ankaratra dans le cadre du processus de sa mise en protection a permis d'identifier les habitats préférentiels de quatre espèces de *Microgale* (Afrosoricida, Tenrecidae, Oryzorictinae), *M. dobsoni*, *M. gymnorhyncha*, *M. gracilis* et *M. longicaudata* d'une part et de rajouter de nouvelles localités sur la distribution géographique de *M. gymnorhyncha* d'autre part. Ainsi, *M. gymnorhyncha* est signalé pour la première fois dans cette partie montagnarde. Concernant les autres espèces, *M. longicaudata* et *M. dobsoni* ont été capturés dans les forêts perturbées munies des grands arbres et à tapis herbacé à Malakialina, entre 1650 et 1750 m d'altitude tandis que *M. gracilis* et *M. gymnorhyncha* ont été rencontrés à une altitude plus élevée, à plus de 1950 m à Tavolotara/Tsiafajavona. Seul, *M. gracilis* a été trouvé à plus de 2150 m d'altitude et de plus, il fréquente les milieux ouverts, dégradés et même dans les formations herbeuses. Par contre, *M. gymnorhyncha* n'a été recensé que dans la formation forestière perturbée à

Tavolotara/Tsiafajavona, ayant une altitude 1950-2000 m. Aucune de ces espèces n'est endémique locale et caractéristique d'Ankaratra, mais quoiqu'il en soit Ankaratra constitue un vestige de leur présence dans les Hautes Terres Centrales de Madagascar. Cette étude nous a permis également d'avancer que ces quatre Afrosoricida rencontrés sont actifs en hiver.

## P27

### Mise à jour de la distribution géographique de *Microgale jobihely*

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Ce travail compile et apporte des informations les plus récentes sur la distribution géographique de *Microgale jobihely* (EN, UICN Liste Rouge), en termes de zone d'occurrence et d'occupation. Une analyse quantitative du statut de protection de cette espèce, par rapport au niveau de chevauchement de son aire géographique avec les aires protégées, les zones de l'empreinte minière et les sites d'offset du projet Ambatovy été menée. Les pertes résiduelles, sur la population sont calculées par des valeurs substituts en terme de surface de chevauchement avec l'empreinte minière d'Ambatovy. Cette espèce a été observée dans 11 localités de trois sites incluant la zone de bail de la mine d'Ambatovy-Analamay, le Corridor Forestier d'Analamay-Mantadia et la Nouvelle Aire Protégée de Bemanekika. Ses zones d'occurrence connues mesurent 3 476 km<sup>2</sup> et celles d'occupation sont de 28 km<sup>2</sup>. Le chevauchement des zones d'occurrence avec l'empreinte minière d'Ambatovy est de 13,8 km<sup>2</sup>. Cette valeur de surface, environ 0,37 % avec la zone d'occurrence totale, peut être considérée comme information de substitut de la perte résiduelle sur la population, liée à la mine d'Ambatovy. La répartition des zones d'occupation semble indiquer trois sous

populations de *M. jobihely*, celle de la Nouvelle Aire Protégée de Bemanevika, du complexe forestier Ambatovy-Analamay et du Corridor Forestier Analamay-Mantadia. Le programme d'offset de biodiversité du projet Ambatovy dans la zone de conservation de la mine et du Corridor Forestier Ankeniheney-Zahamena contribue à compenser les pertes résiduelles, associées avec l'habitat critique de *M. jobihely*.

## P28

### Dietary protein influences exploratory and social behaviour in *Rhabdomys dilectus chakae*

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Caloric restriction during pregnancy and early life can significantly influence the development of social and exploratory behaviour in young rodents, which impacts their behavioural repertoire as adults. We studied whether protein deficiency influenced social and exploratory behaviour in *Rhabdomys dilectus chakae*. Breeding pairs were assigned to one of three isocalorific diets, which differed in protein levels: 1) high protein (HP; 24%); 2) baseline protein (BP; 19%); and 3) low protein (LP; 10 %). Offspring were reared on the same diet as their parents. At 60 days old, 40 same-sex (20 male-male; 20 female-female) dyadic encounters were staged between the HP and LP treatments in a neutral arena. Exploratory behaviour was also assessed in an open field test. Although LP *R. d. chakae* weighed less than HP individuals, LP individuals were more aggressive and won significantly more encounters than HP animals during dyadic encounters. However, LP animals showed lower levels of exploratory behaviour and higher inactivity in the open field compared to HP animals. Our study shows that the level of dietary protein during early development has a significant impact on the development of social and exploratory behaviour of *R. d. chakae*. We conclude that protein deficient *R. d. chakae* trade-off the energetic costs of exploration by increasing aggression, allowing

them to successfully compete for access to potentially limited resources.

## P29

Distribution and nesting behavior of black-and-rufous senги *Rhynchocyon petersi* in Tanzanian coastal forests

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A study on the distribution and nesting behavior of *Rhynchocyon petersi* was conducted in six selected coastal forests in Tanzania between March 2011 and July 2013. We used 10 digital infrared cameras placed in each forest for 15 days to assess the distribution of *R. petersi*. Nineteen animals were collared and tracked to find their nest location. *Rhynchocyon petersi* was found to be distributed in all six forests. A sound knowledge on the current distribution of the species is an essential baseline for conservation planning and mitigation measures. Camera trap rate was used as proxy for response to vegetation variables, which did not differ between forests. Semi-dry tree leaves were the main materials used for nest constructions. Each individual was able to make nests with an average number of 10 nests for males and 12 nests for females. A nest was used more than once. There were no significant differences between females and males in nest size. Construction of nests in shrub habitats was much more preferred to other types of habitats, particularly for females. Nest placements in leaf litter were more preferred by males than for females. The study suggests that nest placements and constructing of more than one nest per individual is linked to food resources availability and avoidance of predation. The distribution of *R. petersi* in these coastal forests is associated with combination of key factors, which are important for the survival of the species. Therefore, protection and conservation of

the species is important especially in forests, which are located outside protected areas.

## P30

Mouse and sportive lemur population densities in the Loky-Manambato region (northern Madagascar)

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Madagascar is one of the hottest biodiversity hotspot and it faces critical rates of deforestation and poaching. As such, it represents a conservation priority. The population of the Daraina sportive lemur (*Lepilemur milanoii*) and Northern mouse lemur (*Microcebus tavaratra*), are confined to relatively small distribution range in northern Madagascar and are present in the Loky-Manambato region. Very little is known about these two species, classified "Data Deficient" and "Vulnerable", respectively, by the IUCN. Despite the successful management of the area by the NGO Fanamby since 2005, no study had been conducted to determine the presence and the abundance of *L. milanoii* and *M. tavaratra* in the main forest fragments of the region. During the 2010 and 2011 dry season, we surveyed ten major forest fragments of the Loky-Manambato region and estimated *L. milanoii* and *M. tavaratra* densities and population sizes using line transect distance sampling and the DISTANCE software. The results suggest that mouse and sportive lemur densities are reasonably high in the region, but with important differences between forest fragments. For the Loky-Manambato region, we were able to estimate population sizes of ~48,000 sportive lemur and ~57,000 mouse lemur individuals. These are the first population size estimates and similar studies should be repeated to monitor environmental changes and anthropogenic pressures (hunting, deforestation, mining, etc.).

## P31

### Use of underground space by a eusocial mole-rat

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Social species of African mole-rats live in family groups occupying large sealed burrow systems which usually have a single communal nest. Their use of space is poorly studied in the field because of the impossibility of direct observation. We radio-tracked 17 individuals of the Ansell's mole-rat (*Fukomys anselli*) from five free-living family groups for six days and subsequently mapped their burrow systems. The burrow systems occupied on average 9600 m<sup>2</sup>, but mole-rat groups utilized only 45% of the burrow system area. All burrow systems were connected with at least one neighbouring burrow system by either freely passable (two cases) or blocked (one case) tunnels. We detected one short visit of a non-breeding female to a territory of a neighbouring group. Within their burrow systems, individual mole-rats walked at least 300 m per day by the existing tunnels. Breeding individuals and large non-breeders tended to spend more time inside the nest and to have smaller home-ranges. In non-breeders, the effect of sex on the spatial activity pattern was negligible. The study was funded by GACR P506/11/1512.

## P32

### New records of bats from northern Namibia

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The northern part of Namibia is characterised by a remarkable gradient of vegetation and climate from west to east towards a more humid and diverse environment. Compared to the central or southwestern parts of the country, the bat fauna of northern Namibia is rather poorly known. Almost a hundred new records of at least 29 bat species belonging to seven families were made during a recent survey in the northern part of the country, making up approximately 83% of the known bat Namibian fauna. Two species, *Mops condylurus* and *Neoromicia cf. melckorum* were recorded in Namibia for the first time. The most common species included *Neoromicia capensis*, *Nycticeinops schlieffenii* and *Chaerephon pumilus*, while some species rare in Namibia were also caught (e.g. *Taphozous mauritianus*, *Mops midas*, *Chaerephon chapini*, *Glauconycteris variegata*, *Vansonia rueppellii*, *Pipistrellus rusticus*, *Neoromicia nana*, *Laephotis botswanae*). Considerable enlargement of the known range of *Epomophorus angolensis* eastwards was documented and also sympatry of two *Epomophorus* species, *E. angolensis* and *E. crypturus*, was observed in NE Namibia. Some notes on echolocation characteristics of the documented bat species are provided.

### P33

The Late Pleistocene species-area relationship for Malagasy small mammals

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A worldwide survey of Late Pleistocene islands, including the West Indies, the Philippines, Wallacea, the Galápagos, the Mediterranean, and several smaller islands and archipelagos, shows that the Species Area Relation is significant and strong. We calculated the number of species that Madagascar should have harboured before the arrival of humans by adding the species known from the subfossil record to the present diversity. Based on its surface area and the correlation found for the other islands, the total number of Malagasy mammal species is higher than expected. However, when

only applied to Malagasy rodents, the total number is lower than expected. Also, the speciation rate of these small mammals is lower than expected, relative to other islands. This dramatic difference could be explained by unknown extinctions, as species that disappeared from Madagascar without leaving a fossil trace or other evidence were consequently not noted in the fauna list. This stands in sharp contrast with the fossil record of large mammals: lemurs and hippos. This research was co-financed by the European Union (European Social Fund) and Greek national funds through the Operational Program "Education and Lifelong Learning" of the National Strategic Reference Framework (NSRF)---Research Funding Program: THALIS---UOA "Island biodiversity and cultural evolution: Examples from the Eastern Mediterranean, Madagascar, Mauritius and Philippines during the past 800.000 years" (MIS375910, KA:70/3/11669).







